United States
Department of
Agriculture

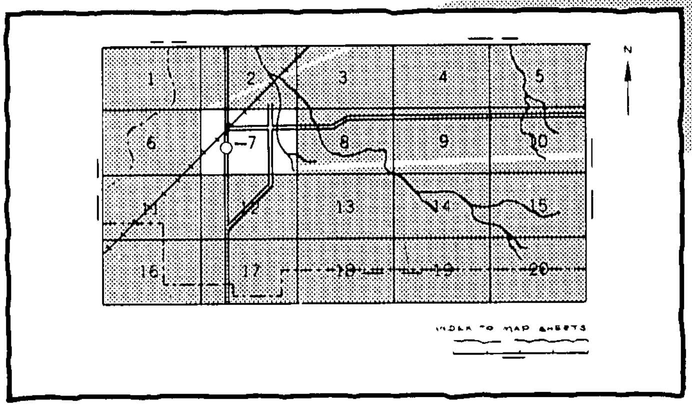
Soil
Conservation
Service

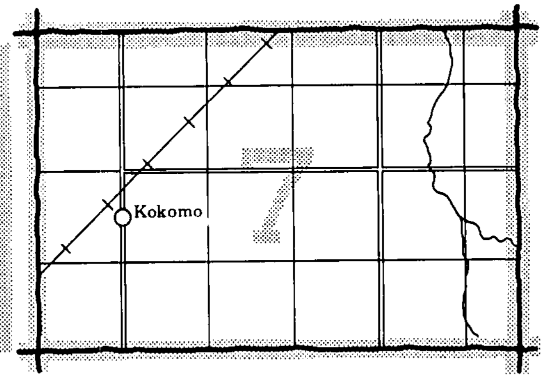
In cooperation with
University of Nebraska,
Conservation and
Survey Division

Soil Survey of Wheeler County, Nebraska

HOW TO USE

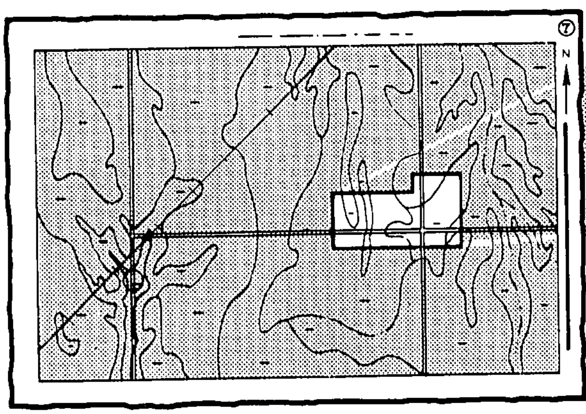
1. Locate your area of interest on the "Index to Map Sheets."

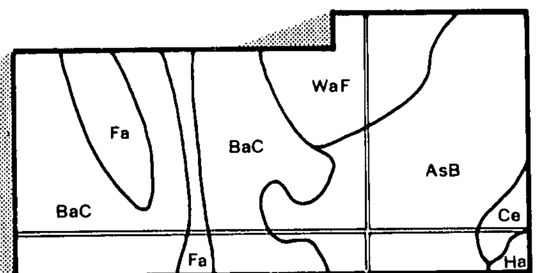




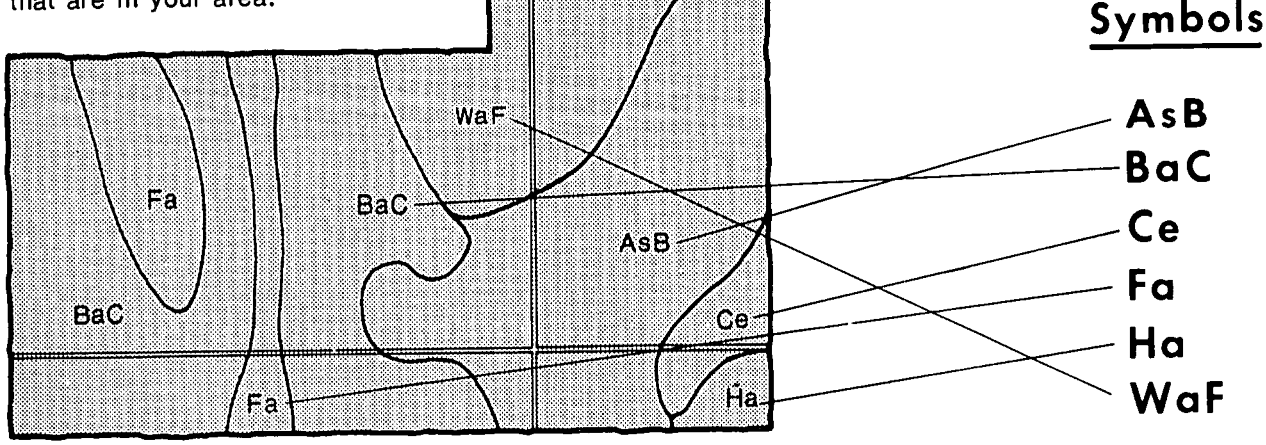
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



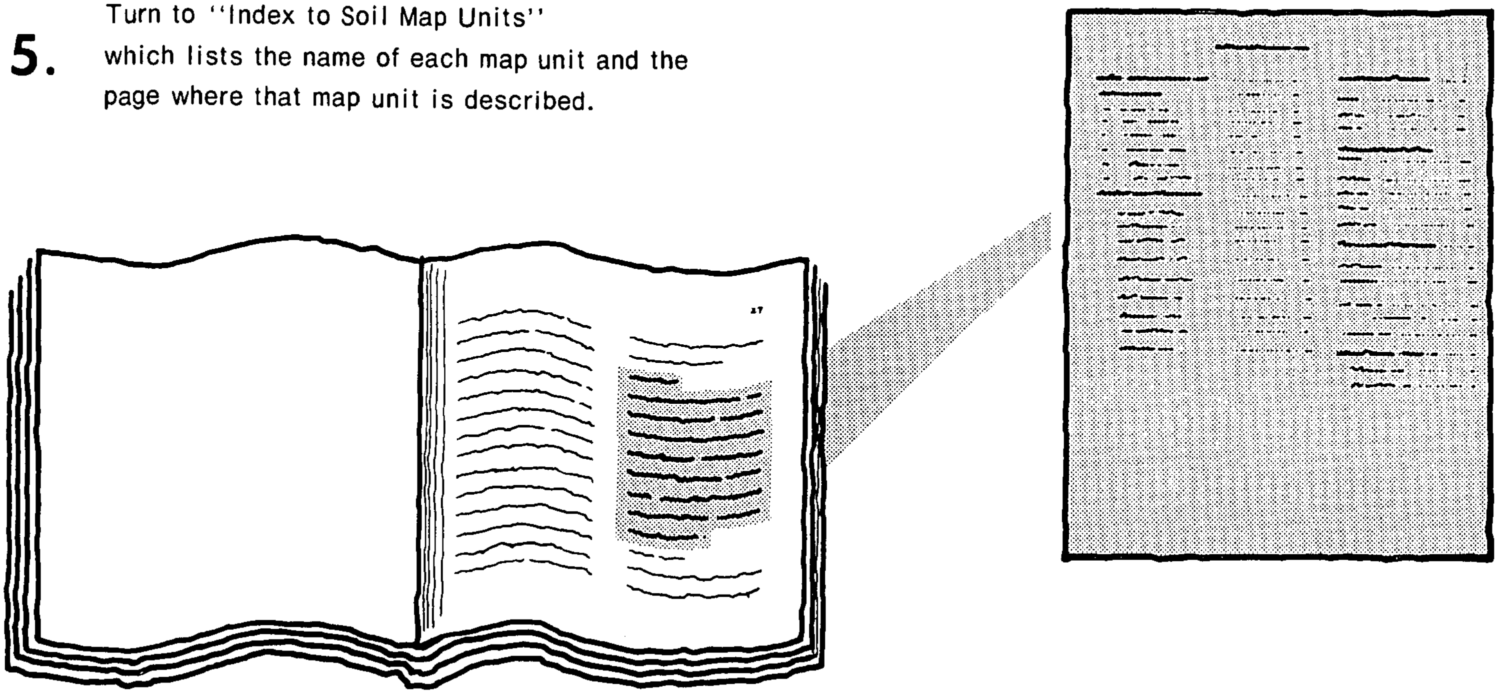


4. List the map unit symbols that are in your area.

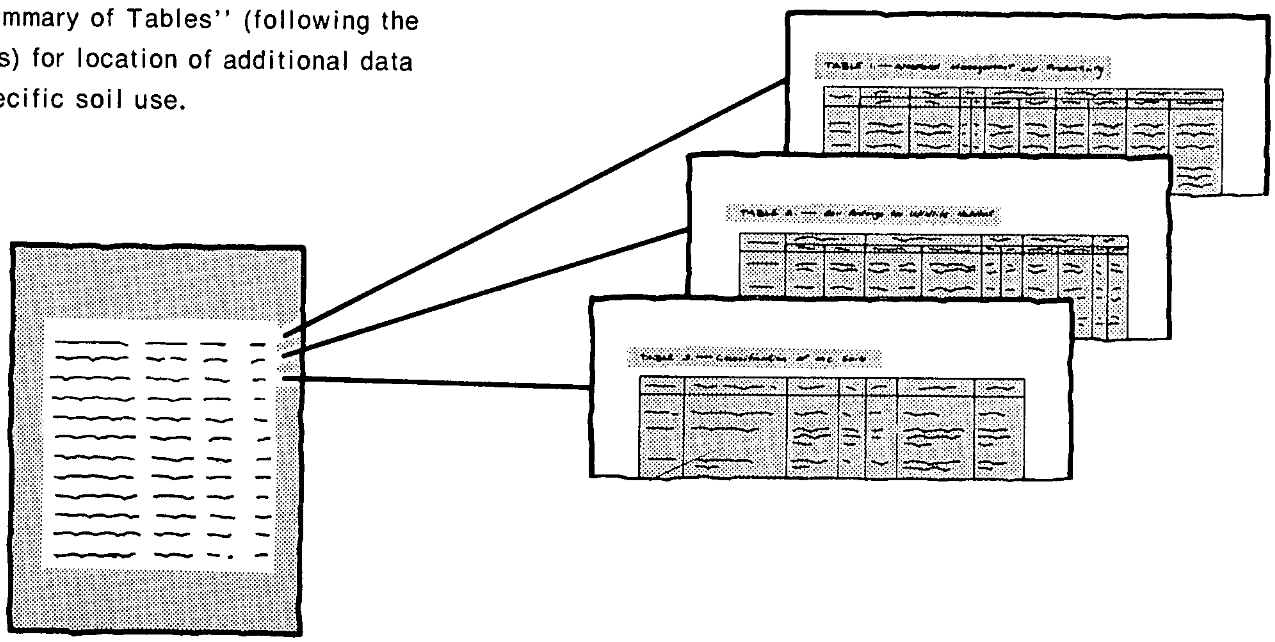


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed during the period 1979 to 1983. Soil names and descriptions were approved in 1984. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Upper Elkhorn and Lower Loup Natural Resource Districts. The Wheeler County Board of Commissioners and the Upper Elkhorn and Lower Loup Natural Resource Districts provided financial assistance to fund aerial photography, and the upper Elkhorn and Lower Loup Natural Resource Districts provided financial assistance to accelerate soil mapping.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Farmstead and field windbreaks, hayland, and native range in an area of the Els-Valentine-Ipage association. An area of the Valentine association is in the background.

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Soil Series

Issued September 1988

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Wheeler County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Sherman L. Lewis
State Conservationist
Soil Conservation Service

Soil Survey of Wheeler County, Nebraska

By Orville Indra, Soil Conservation Service, and Stephen J. Lobaugh and Jeffery Green, University of Nebraska, Conservation and Survey Division

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the University of Nebraska, Conservation and Survey Division

WHEELER COUNTY is located slightly to the northeast of the geographical center of Nebraska (fig. 1). The county is nearly square, having boundaries of about 24 miles on each side. It is bordered on the north by Holt County, on the west by Garfield County, on the south by Greeley County, and on the east by Antelope and Boone Counties. It has a total area of 368,064 acres, or about 575 square miles. Bartlett, the largest town and the county seat, is in the central part of the county. Ericson is the only other town in the county.

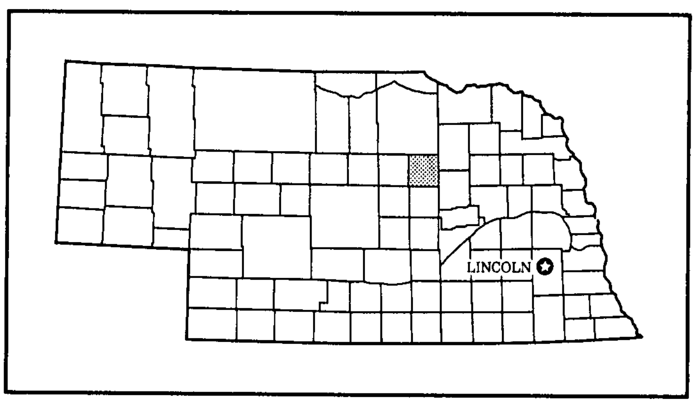

Figure 1.—Location of Wheeler County in Nebraska.

The economy of the county is based primarily on cattle ranching, hay production, and irrigated corn. Other kinds of commerce and industry, however, also are important. These include cattle feeding and distribution of fertilizer and farm chemicals. Farming, ranching, cattle feeding, and agribusiness provide most of the employment opportunities in the county.

About 75 percent of the county is range, and 20 percent is cropland. Since inadequate seasonal rainfall restricts the growth of crops in most years, about 75 percent of the cropland is irrigated.

The soils in Wheeler County vary widely in texture, drainage, and other characteristics. Those in the northern two-thirds of the county are mostly sandy. They formed in sandy eolian and alluvial material. This part of the county is characterized by rolling and hilly sandhills and broad, flat valleys. The soils in the valleys have a seasonal high water table. Ranching and hay production are the main agricultural enterprises. In recent years the introduction of center-pivot irrigation has considerably increased the acreage used for irrigated crops in this area. The seasonal high water table and soil blowing are the principal management concerns if these soils are farmed.

The soils in the southern third of the county are transitional. They include steep and hilly soils on sandhills and loamy sands and fine sandy loams on gently rolling hills. The extreme southeast corner of the county has steep loess hills and silty soils. Most of the dryland crops in the county are grown in this area. When these soils are irrigated, both towline and center-pivot systems are used. Soil blowing and water erosion are the principal hazards. Conserving moisture and controlling erosion are the principal management concerns.

This soil survey updates the survey of Wheeler County published in 1937 (*1*). It gives additional information and has large maps, which show the soils in greater detail.

General Nature of the County

This section provides general information about Wheeler County. It describes history and development; climate; geology and ground water; physiography, drainage, and relief; and trends in farming and land use.

History and Development

The first permanent settlement in the area now called Wheeler County was established in 1874, in what was then unorganized territory. The county was founded by an act of the state legislature in 1877 and was organized in 1879. The western half was established as Garfield County in 1884, leaving Wheeler County with its present boundaries (*1*).

According to federal census reports, the county had 644 inhabitants in 1880; 1,683 in 1890; 1,362 in 1900; 2,292 in 1910; and 2,531 in 1920. During the next few decades, the population decreased. It was 2,335 in 1930; 2,170 in 1940; 1,526 in 1950; 1,297 in 1960; 1,047 in 1970; and 1,060 in 1980. The population density decreased from a high of nearly 4.5 persons per square mile in 1920 to less than 2 per square mile in 1980. Settlement is densest in the loess-covered hills in the southeast corner of the county. The sandhills are sparsely settled. Bartlett has a population of 144, and Ericson has one of 132 (*8*).

Bartlett has several fertilizer and feed distributors. Ericson has an auction livestock market. One of the largest cattle-feeding enterprises in the state is in the northwestern part of the county.

There are two major highways in the county. U.S. Highway 281 crosses the county from north to south. Nebraska Highway 70 crosses the county from the southwest corner to the northeast corner. These are the only hard-surfaced, all-weather roads in the county. The county roads are made of earth. They are fairly well developed and follow section lines in the more densely settled parts of the county, but they are very poorly developed and scarce in the sparsely settled sandhills.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

The climate in Wheeler County is characterized by cold winters and long, hot summers. Heavy rains occur mainly in spring and early in summer, when moist air from the Gulf of Mexico interacts with drier continental air. The annual rainfall usually is adequate for corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at York, Nebraska, in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 26 degrees F, and the average daily minimum temperature is 15 degrees. The lowest temperature on record, which occurred at York on January 12, 1974, is -25 degrees. In summer the average temperature is 75 degrees, and the average daily maximum temperature is 88 degrees. The highest recorded temperature, which occurred at York on July 11, 1954, is 111 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 27 inches. Of this, about 20 inches, or nearly 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 16 inches. The heaviest 1-day rainfall during the period of record was 4.35 inches at York on June 24, 1952. Thunderstorms occur on about 42 days each year. Tornadoes and severe thunderstorms strike occasionally, but they are local in extent and of short duration and cause damage in scattered spots. Hail falls in scattered small areas during the warmer part of the year.

The average seasonal snowfall is 33 inches. The greatest snow depth at any one time during the period of record was 29 inches. On the average, 6 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 75 percent. The sun shines 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 14 miles per hour, in spring.

Geology and Ground Water

The bedrock in Wheeler County is the Ogallala Formation of Miocene age. It consists of beds of sand, lime-cemented sandstone, sandy silt, and some limy zones. Unconsolidated sand and gravel deposits of Quaternary age overlie this formation throughout the county. Sandy to clayey Illinoian deposits overlie the older Quaternary deposits. The surface mantle consists of eolian sand, loess, and alluvium.

About 80 percent of the county has a mantle of sandy eolian material and has hummocks and hills ranging from 5 to 100 feet in height. The dune topography probably formed during arid intervals in late Quaternary time. The area, including the hilly dunes, was stabilized by prairie grasses and forbs. In the southeast corner of the county, the uplands are capped with Peorian Loess. Sandy

alluvium is deposited along the major streams. Silty alluvium is deposited on stream terraces, which make up only a few hundred acres in the county.

The Cedar River, in the southwestern part of the county, and Beaver Creek, in the east-central part, are the only perennial streams in the county. Water for livestock is provided by wells because the county has few lakes. Wells in both the Quaternary deposits and the Ogallala Formation provide water for domestic uses and livestock and for irrigation. The Quaternary material, however, is the principal aquifer for most wells.

The ground water throughout the county is of good quality, and the supply is adequate for all purposes. Water from shallow wells in the sandy eolian material is low in content of dissolved minerals and is soft, and water from deep wells is hard. Wells in the uplands range from 80 to 400 feet in depth. In the subirrigated valleys and in the alluvial areas, water is within a depth of 20 feet. Flowing wells are in the stream valleys. They are most numerous in the valley of Beaver Creek.

Ground water can be contaminated by drainage from feedlots, septic tanks, and other waste disposal systems. When a domestic well is installed, a sample of the water should be tested for contamination before the well is connected to the water system. Existing domestic wells should be occasionally tested for contamination. Shallow wells tend to be more susceptible to contamination than deep wells.

The county has 488 registered irrigation wells. Most yield about 800 to 1,200 gallons per minute, but higher yielding wells can be developed in some areas.

Physiography, Drainage, and Relief

Wheeler County is in the Great Plains physiographic province. The topography consists of three general kinds of landforms, which are separated on the basis of surface and internal drainage. These are areas of well drained soils on uplands and terraces, excessively drained soils on uplands and sandhills, and soils in subirrigated valleys and on bottom land along streams.

The well drained soils on uplands and terraces are silty soils that formed in loess-covered areas and sandy soils that formed in the loess-sandhill transition zone. The largest area of silty soils is in the extreme southeast corner of the county. It is 18 square miles in size. Small areas where loess is deposited and silty soils have formed also are in the northeast corner of the county. Slopes range from nearly level on the terraces to strongly sloping in the uplands. All of these areas are characterized by a good surface drainage pattern and good internal drainage. None of the soils are droughty. Nearly all are cultivated and are suited to both dryland and irrigated crops. The silty soils on uplands include Gates and Uly soils and the strongly sloping Coly soils. Hord, Hobbs, and Nimbro soils are on the terraces.

The sandy soils in the transition zone in the uplands include Anselmo, Boelus, Dunday, Hersh, and Loretto soils. This area is characterized by a well expressed surface drainage pattern and good internal drainage. Most of the area is used for both dryland and irrigated crops.

The excessively drained soils in the uplands include the nearly level to very steep Valentine soils and the moderately steep to very steep Coly soils. The Valentine soils are in the sandhill area, which extends across the central part of the county from east to west and includes the southwest corner of the county. The sandhills rise 10 to more than 200 feet above the intervening valleys and swales. Small lakes and wet areas are in some of the valleys and swales. Blowouts are common throughout the sandhills. The Valentine soils have a thin layer of topsoil and a low available water capacity and are droughty. They are used mainly for range. The Coly soils are in loess-covered areas that are dissected by deep drainageways and are subject to excessive erosion. They have a thin layer of topsoil, a low organic matter content, and a high available water capacity. Some areas of these soils on the lower slopes and broad ridgetops can be cultivated if they are carefully managed. Most areas of both the Coly and Valentine soils are best suited to range.

The subirrigated valleys occur as broad, nearly level and very gently sloping bottom land along Clearwater and Beaver Creeks, in the northern part of the county. Narrow bands of bottom land also are along the Cedar River, Dry Cedar Creek, Clear Creek, and other small streams in the southern part of the county. The subirrigated valleys extend through transitional areas of low, hummocky and rolling sandhills. The very poorly drained Marlake soils and Fluvaquents, the poorly drained Loup and Tryon soils, and the somewhat poorly drained Els, Elsmere, Gibbon, Ord, and Selia soils are in these valleys. They have a high water table, which permits the growth of luxuriant stands of native grasses. These grasses are best used as native hay. As the streams flow east, they become more deeply entrenched and the better drained soils can be used for corn and alfalfa.

Trends in Farming and Land Use

Ranching and farming have been the most important enterprises in Wheeler County since its settlement. Livestock ranching is the main agricultural enterprise. Corn production is the second most important farm enterprise. About 26 percent of the county is cropland. About 60 percent of the cropland is irrigated. Water for irrigation is drawn mostly from wells and applied by center-pivot systems. Corn is the main irrigated crop. Alfalfa, corn, sorghum, and small grain are the main nonirrigated crops. About 70 percent of the county

supports native grass that is used for grazing or is cut for hay. Less than 1 percent of the county is woodland.

The number of farms and ranches in the county decreased from 175 in 1978 to 170 in 1982. The size of farms and ranches increased during the same period. The acreage of harvested cropland increased from 72,754 acres in 1978 to 95,397 acres in 1982. The acreage of irrigated land increased from 26,928 acres in 1978 to 55,000 acres in 1983. The acreage used for pasture and range decreased (*4*). Many operating units are ranches used primarily for raising livestock, mainly cow-calf herds. Most of these operating units combine ranching with dryland and irrigated farming.

Enterprises that raise cattle and sell calves in the fall as feeders are among the largest industries in the county. The number of cattle-feeding enterprises has increased significantly in recent years. The number of cattle in feedlots was 4,000 head in 1970 and an estimated 90,000 head in 1982. Much of this increase can be attributed to several large operations, which have come into the county in recent years. Hogs are raised on some farms and are fattened in feedlots or sold as feeder pigs. Other livestock is raised on a few farms but not in significant numbers. The county has about 160,000 beef cattle and calves, 1,000 milk cows, and 7,000 hogs (*4*).

Because of the introduction of center-pivot irrigation in the past 10 years, corn grown as a cash crop has become important to the economy in Wheeler County. According to the Nebraska Department of Water Resources, the county had 488 registered wells in 1984. These were used to irrigate more than 55,000 acres.

The acreage of irrigated corn harvested for grain increased from 2,840 acres in 1969 to 29,600 acres in 1982. The acreage used for dryland corn increased from 7,500 acres in 1969 to 8,800 acres in 1982. The acreage of irrigated alfalfa increased from 400 acres in 1969 to 4,500 acres in 1982. The acreage of nonirrigated alfalfa decreased from 5,400 to 3,900 acres during this period. The acreage used for wheat, oats, and soybeans has not changed significantly in recent years. Popcorn has been grown on a small acreage in recent years.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example,

data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to

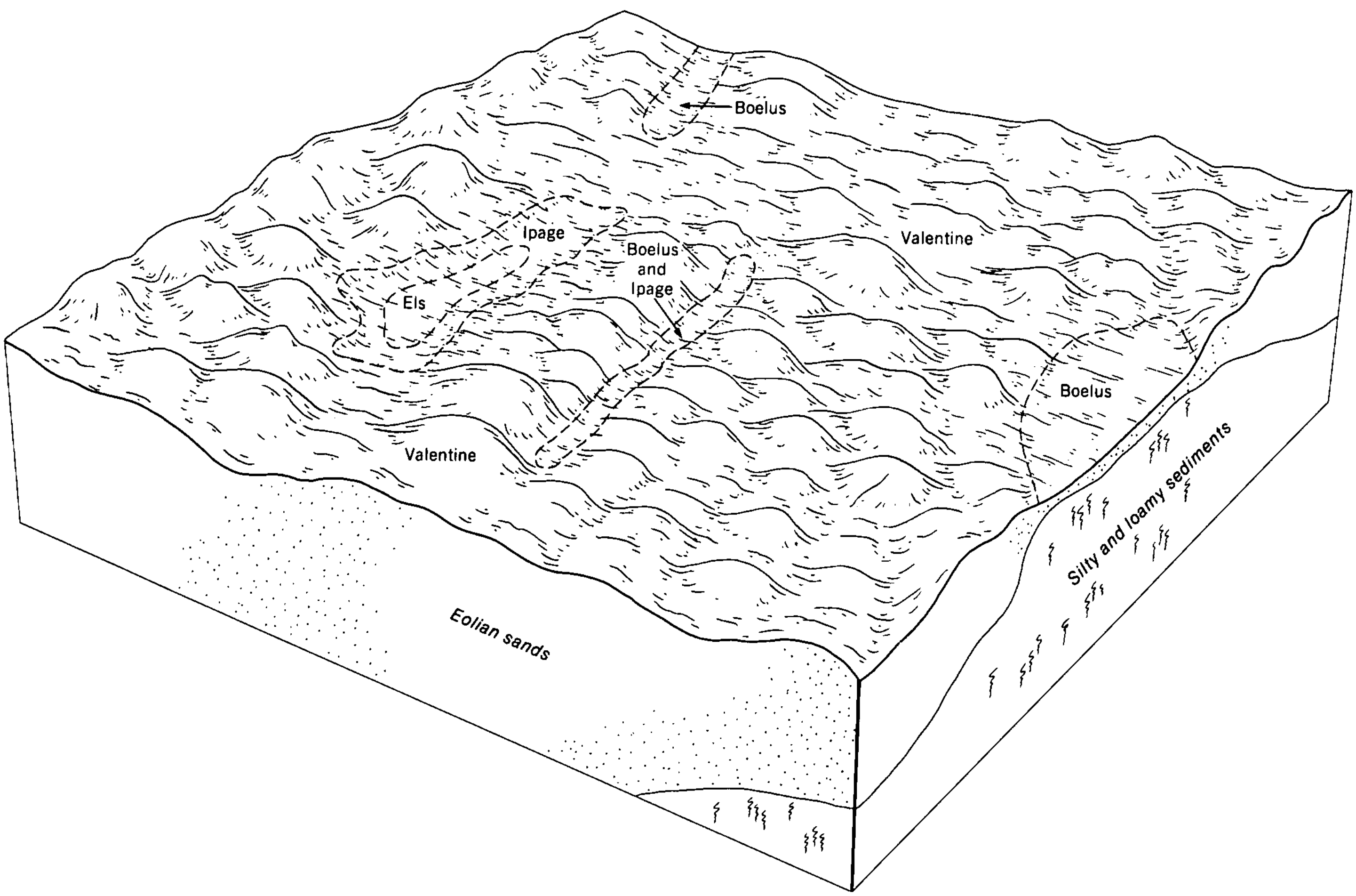

Figure 2.—Pattern of soils and parent material in the Valentine association.

place in slope, depth, drainage, and other characteristics that affect management.

Some of the soil boundaries and soil names on the general soil map of this county do not fully match those on the maps of adjacent counties published at an earlier date. Differences result from changes and refinements in series concepts, variations in slope groupings, and application of the latest soil classification system.

Soil Descriptions

1. Valentine Association

Deep, gently sloping to very steep, excessively drained, sandy soils formed in eolian sand; on upland sandhills

This association consists of soils on long ranges of hills and in the intervening swales and valleys. The hills are low, rounded dunes or high, steep dunes. They are generally oriented in an east-west direction. Many rise as much as 200 feet above the valley floors. The soils in the valleys and swales are rarely affected by a high water table. Slopes range from 3 to 60 percent.

The total area of this association is 153,315 acres, or about 42 percent of the county. The association is about 95 percent Valentine soils and 5 percent minor soils and miscellaneous land types (fig. 2).

Typically, the surface layer of the Valentine soils is grayish brown, loose fine sand about 5 inches thick. The transition layer is pale brown, loose fine sand about 7 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand.

Minor in this association are Blowout land and the Ipage, Els, Boelus and Dunday soils. Blowout land is mostly barren of vegetation and consists of loose fine sand that shifts easily as the wind blows. Ipage soils are in sandhill valleys and are moderately well drained. Els soils are in low positions in the valleys and are somewhat poorly drained. Boelus and Dunday soils are well drained and are in the higher valleys and on gently sloping sandhills.

Most of this association has a cover of native grasses and is used for grazing. Ranching is the main enterprise. Most ranchers raise feeder calves and yearlings. Little hay is grown because the valleys are too narrow for much more than an occasionally grown meadow crop.

The main concern in managing range is reducing the hazard of soil blowing caused by overgrazing. The range condition can be maintained or improved by proper grazing use, timely deferment of grazing, and a grazing system that alternates grazing periods with rest periods and changes the order of these periods each year.

The Valentine soils are too sandy and too steep for cultivated crops. Some areas are being developed for sprinkler irrigation. If cultivated crops are grown, drought and soil blowing are management problems. Keeping crop residue on the surface and applying a system of conservation tillage help to control soil blowing and conserve moisture.

2. Dunday-Valentine-Boelus Association

Deep, nearly level to strongly sloping, well drained and excessively drained, sandy soils formed in eolian sand and in eolian sand over loamy and silty sediments; on uplands and stream terraces

The total area of this association is 59,070 acres, or about 16 percent of the county. The association is about 38 percent Dunday soils, 37 percent Valentine soils, 11 percent Boelus soils, and 14 percent minor soils (fig. 3). Slopes of the major soils range from 0 to 9 percent.

The Dunday soils are nearly level to gently sloping and are well drained. They formed in sandy eolian material on uplands and stream terraces. They generally are lower on the landscape than the Valentine soils. Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 9 inches thick. The subsurface layer also is dark grayish brown, very friable loamy fine sand. It is about 5 inches thick. The transition layer is grayish brown, very friable loamy sand about 9 inches thick. The underlying material to a depth of more than 60 inches is fine sand. It is pale brown in the upper part and very pale brown in the lower part.

The Valentine soils are nearly level to strongly sloping and are excessively drained. They formed in sandy eolian material. They generally are higher on the landscape than the Dunday soils. Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 7 inches thick. The transition layer is pale brown, loose fine sand about 7 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand.

The Boelus soils are nearly level to gently sloping and are well drained. They formed in sandy eolian material over loamy and silty sediments. They are lower on the landscape than the Dunday soils or are in similar landscape positions. Typically, the surface layer is dark grayish brown, very friable loamy sand about 6 inches thick. The subsurface layer is about 16 inches thick. It is dark grayish brown, very friable loamy fine sand in the upper part and pale brown, loose fine sand in the lower part. The subsoil is yellowish brown, firm sandy clay loam about 12 inches thick. The underlying material to a depth of more than 60 inches is light yellowish brown silt loam.

Minor in this association are the Ipage, Loretto, Gates, and Anselmo soils. Ipage and Loretto soils are in landscape positions similar to those of the Boelus soils. Ipage soils are moderately well drained. They are sandy throughout. Loretto soils have a loamy surface layer and a silty and loamy subsoil. They are well drained. Gates and Anselmo soils are in the higher landscape positions and are well drained. They are finer textured than the major soils. Anselmo soils have a dark surface layer that is more than 7 inches thick. Also of minor extent are some areas of moderately steep sandhills.

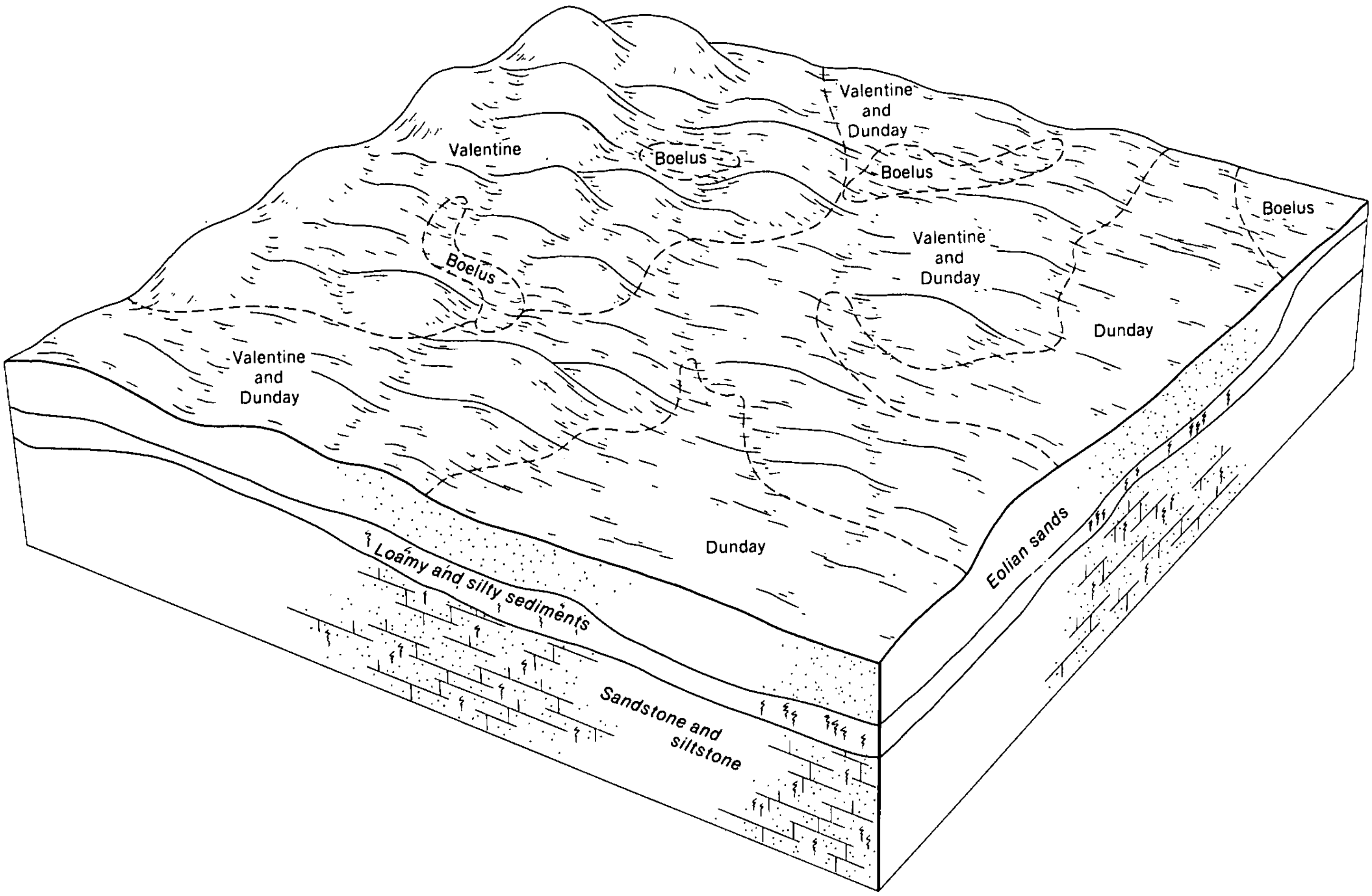

Figure 3.—Pattern of soils and parent material in the Dunday-Valentine-Boelus association.

Farms in areas of this association are a combination of cash-grain and livestock enterprises. The nearly level to gently sloping soils are used for cultivated crops. The moderately steep soils are generally used for range. A large acreage of the cropland is irrigated by center-pivot sprinkler systems. The main dryland crops are corn, small grain, and alfalfa. The main irrigated crops are corn and alfalfa. The soils are too sandy for gravity irrigation. Sites for high-yielding wells that provide water suitable for irrigation are available in most areas. Wells on the farms provide water for livestock and domestic uses.

Soil blowing is the main hazard in the cultivated areas. Inadequate seasonal rainfall is a limitation on dryfarmed cropland in some years. Maintaining a cover of crops or crop residue and establishing field windbreaks help to control soil blowing. Maintaining fertility and increasing the organic matter content are management concerns. The main concerns in managing range are controlling erosion and maintaining or improving the vigor of the native grasses. Range management should include proper stocking rates and a planned grazing system.

3. Els-Valentine-Ipage Association

Deep, nearly level to strongly sloping, somewhat poorly drained, excessively drained, and moderately well drained, sandy soils formed in eolian and alluvial sands; in sandhill valleys and on uplands

This association consists of soils on low, hummocky sandhills and in the intervening valleys. Most of the dunes or hummocks are less than 15 feet high. A few small areas in the sandhills are moderately steep. The association is in the transition area between the sandhills and the broad, flat valleys. Slopes range from 0 to 9 percent.

The total area of this association is 58,880 acres, or about 16 percent of the county. The association is about 35 percent Els soils, 26 percent Valentine soils, 25 percent Ipage soils, and 14 percent minor soils (fig. 4).

The Els soils are nearly level and are in sandhill valleys. They are somewhat poorly drained. The depth to the seasonal high water table ranges from about 1.5 feet in wet years to 3.0 feet in dry years. Typically, the

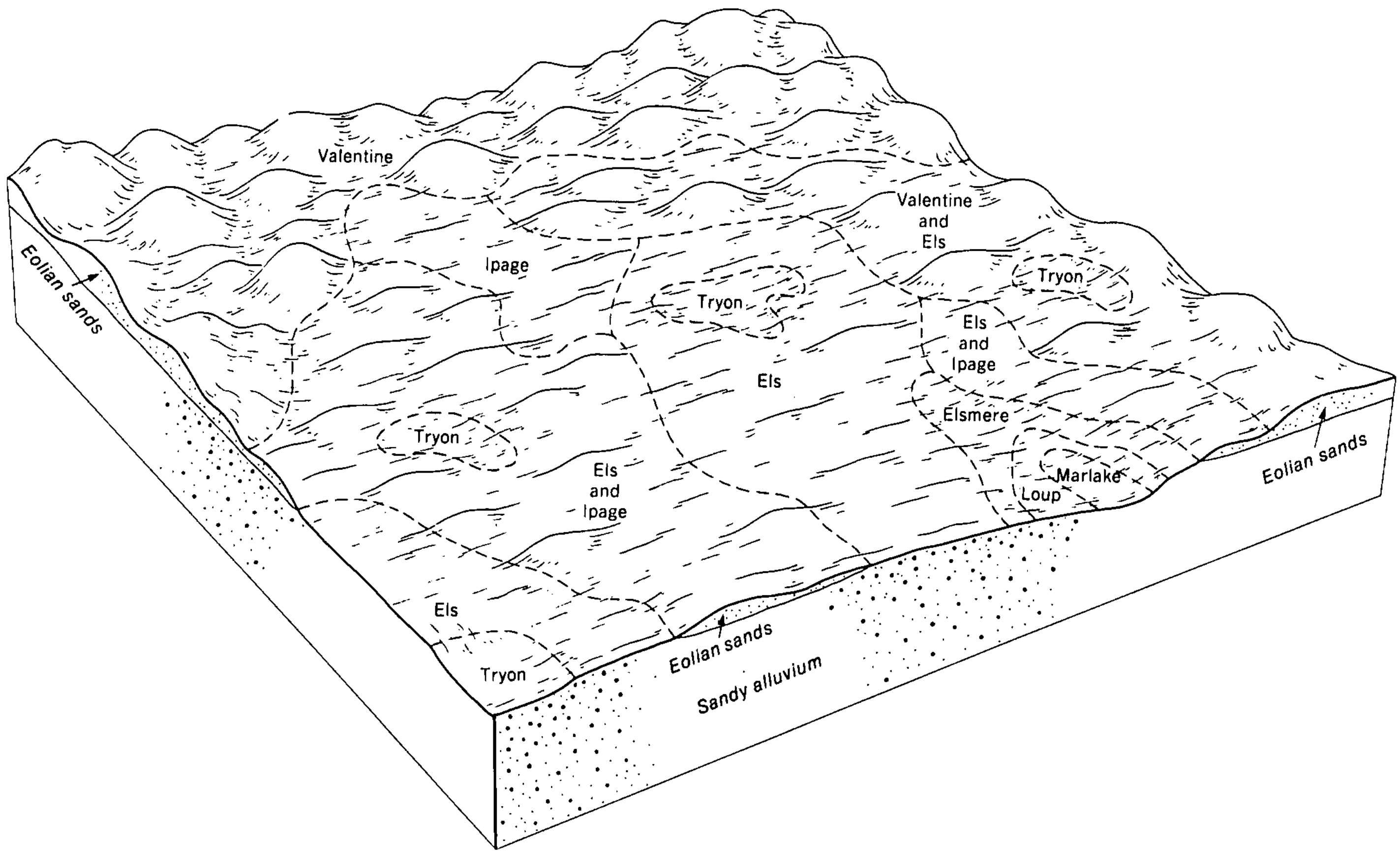

Figure 4.—Pattern of soils and parent material in the Els-Valentine-Ipage association.

surface layer is dark grayish brown, very friable loamy sand about 7 inches thick. The transition layer is grayish brown, very friable loamy sand about 9 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand.

The Valentine soils are gently sloping and strongly sloping and are on hummocky dunes. They are excessively drained. Typically, the surface layer is grayish brown, very friable fine sand about 6 inches thick. The transition layer is pale brown, loose fine sand about 4 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand.

The Ipage soils are nearly level and very gently sloping and are in transition areas between the Valentine and Els soils. They are moderately well drained. The depth to the seasonal high water table ranges from about 3 feet in wet years to 6 feet in dry years. Typically, the surface layer is grayish brown, very friable fine sand about 5 inches thick. The transition layer is light brownish gray, loose fine sand about 6 inches thick. The underlying material to a depth of more than 60 inches is light gray fine sand. Common, fine, distinct mottles are below a depth of 32 inches.

Minor in this association are the Tryon, Loup, Elsmere, Libory, and Marlake soils and Blownout land. Tryon and Loup soils are lower on the landscape than the Els soils and have a water table closer to the surface. Elsmere soils are in landscape positions similar to those of the Els soils. They are dark to a depth of more than 10 inches. Libory soils are on stream terraces. They have loamy underlying material. Marlake soils are in the lowest positions on the landscape and are covered by water much of the time. Blownout land is common throughout this association. It is mostly barren of vegetation and consists of loose fine sand that shifts easily as the wind blows.

Most of the acreage in this association has a cover of native grasses and is used for range or hay. Ranching is the main enterprise. Most of the ranchers raise feeder calves and yearlings. A few fatten cattle in feedlots. A few farms are a combination of livestock and cash-grain enterprises. The main concern in managing range is establishing a planned grazing system that includes

proper grazing use. Also, soil blowing is a hazard. If the protective grass cover is destroyed, blowouts can form. Wells that produce high yields can be readily drilled in areas of this association. They yield water of good quality for livestock and irrigation.

In most areas the soils in this association are too hummocky and too sandy for dryland crops. Some areas in the valleys, however, are dryfarmed. Alfalfa and corn are the main dryland and irrigated crops. The main hazards on the Valentine soils are soil blowing and drought. Keeping crop residue on the surface, stripcropping, applying a system of conservation tillage, and establishing field windbreaks help to control soil blowing and conserve moisture. Some areas can be developed for sprinkler irrigation, but soil blowing and wetness are serious problems. Irrigation is mostly by center-pivot sprinkler systems. Wetness can be a problem in the low lying areas. The seasonal high water table in the Els soils is a management concern. It enhances the growth of grasses and cultivated crops in dry periods, but can cause severe wetness in periods of above normal rainfall. Increasing the organic matter content and improving fertility are additional management concerns.

4. Elsmere-Loup-Ipage Association

Deep, nearly level and very gently sloping, moderately well drained to very poorly drained, sandy and loamy soils formed in eolian and alluvial sands; on bottom land, on stream terraces, and in sandhill valleys

This association consists of soils on bottom land and stream terraces along the major streams and in sandhill valleys. Low sandhills are in small isolated areas. Slopes range from 0 to 3 percent.

The total area of this association is 55,870 acres, or about 15 percent of the county. The association is about 40 percent Elsmere soils and similar soils that are somewhat poorly drained, 38 percent Loup soils, 9 percent Ipage soils, and 13 percent minor soils.

The Elsmere soils are nearly level and are on bottom land and in sandhill valleys. They are somewhat poorly drained. The depth to the seasonal high water table ranges from about 1.5 feet in wet years to 3.0 feet in dry years. Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 12 inches thick. The subsurface layer is grayish brown, very friable loamy fine sand about 4 inches thick. The transition layer is light brownish gray, very friable loamy sand about 8 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand.

The Loup soils are nearly level and are on bottom land and in the sandhill valleys. They are poorly drained and very poorly drained. The seasonal high water table is about 0.5 foot above the surface in wet years and is within a depth of about 1.5 feet in dry years. Typically, the surface layer is dark gray, very friable fine sandy loam about 6 inches thick. The subsurface layer is friable and very friable fine sandy loam about 10 inches thick. It is very dark gray in the upper part and dark gray in the lower part. The transition layer is gray, loose fine sand about 10 inches thick. It has brown mottles. The underlying material to a depth of more than 60 inches is light gray fine sand. It has distinct, yellowish brown mottles.

The Ipage soils are nearly level and very gently sloping and are on stream terraces and in sandhill valleys. They are moderately well drained. The depth to the seasonal high water table ranges from about 3 feet in wet years to 6 feet in dry years. Typically, the surface layer is dark grayish brown, very friable loamy sand about 4 inches thick. The transition layer is grayish brown, very friable loamy sand about 7 inches thick. The underlying material to a depth of more than 60 inches is pale brown and very pale brown fine sand.

Minor in this association are the Valentine, Tryon, Marlake, Inavale, and Ord soils. Valentine soils are in the highest positions on the landscape. They are sandy throughout and are excessively drained. Tryon soils are in landscape positions similar to those of the Loup soils. They have a dark surface layer that is less than 7 inches thick. Marlake soils are in the lowest landscape positions and are ponded for longer periods than the Loup soils. Inavale soils are somewhat excessively drained and are along stream channels. Ord soils contain more clay in the upper part than the major soils. They are in landscape positions similar to those of the Elsmere soils.

In most areas this association has a cover of native grasses. A large acreage of the native grasses is harvested for hay. The association is well suited to native hay because of subirrigation by the seasonal high water table. The most extensive hayland in Wheeler County is in this association. A large acreage is suitable as cropland, but less than 10 percent of the association is used for crops. Most of the cropland is irrigated by center-pivot sprinkler systems. Only a small acreage of tame grasses is irrigated. Alfalfa and corn are the main dryland and irrigated crops. Most of the corn is marketed as a cash-grain crop. The rest is harvested as feed grain or silage and fed to livestock.

Ranching is the main enterprise. Most ranchers raise feeder calves and yearlings. Some fatten cattle in feedlots. The farms in areas of this association are diversified. They are mainly a combination of livestock and cash-grain enterprises. Where it is in good condition, the range supports mainly tall native grasses. The main concern in managing range is establishing a planned grazing system that includes proper grazing use. Overgrazing or improper haying methods deplete the protective plant cover and cause deterioration of the plant community.

Wetness and soil blowing are the main management problems in cultivated areas. Alkalinity is a severe limitation in some areas. The seasonal high water table in the Elsmere and Loup soils enhances the growth of

grasses and cultivated crops during dry periods but can interfere with haying and tillage during wet periods. A drainage system is needed before some areas can be irrigated. In most areas of the Elsmere soils, tile drains and drainage ditches are not needed, but the water table can be a problem in years of above normal rainfall. The Loup soils are too wet for crops. Soil blowing can be controlled by maintaining a cover of crops or crop residue and by establishing field windbreaks.

5. Valentine-Els Association

Deep, nearly level to rolling, excessively drained and somewhat poorly drained, sandy soils formed in eolian and alluvial sands; on uplands and in sandhill valleys

This association consists of soils in moderately steep areas on sandhills and in the intervening valleys or swales. Many of the dunes rise as much as 100 feet above the valleys. The soils in the valleys and swales have a high water table.

The total area of this association is 27,200 acres, or about 7 percent of the county. The association is about 77 percent Valentine soils, 16 percent Els soils, and 7 percent minor soils (fig. 5).

The Valentine soils are nearly level to moderately steep and are on hummocky and dunelike uplands. They are excessively drained. Typically, the surface layer is grayish brown, loose fine sand about 5 inches thick. The transition layer is light brownish gray, loose fine sand about 6 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand.

The Els soils are nearly level and are in the valleys. They are somewhat poorly drained. The depth to the seasonal high water table ranges from about 1.5 feet in wet years to 3.0 feet in dry years. Typically, the surface layer is dark grayish brown, very friable fine sand about 6 inches thick. The transition layer is light brownish gray, loose fine sand about 4 inches thick. The underlying material to a depth of more than 60 inches is very pale brown sand.

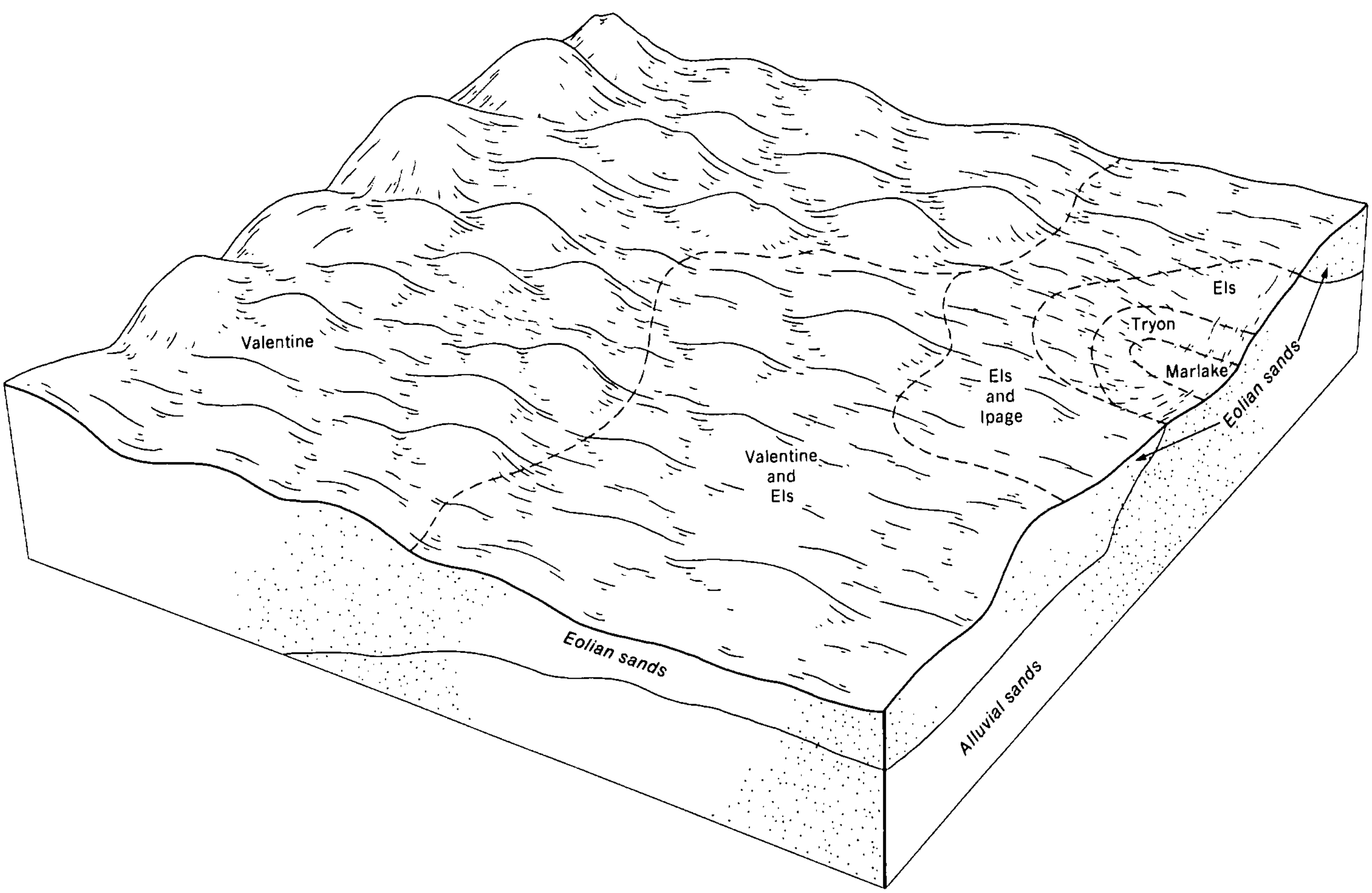

Figure 5.—Pattern of soils and parent material in the Valentine-Els association.

Minor in this association are the Ipage, Dunday, Boelus, Tryon, and Marlake soils and Blownout land. Ipage soils are higher on the landscape than the Els soils and are moderately well drained. Dunday and Boelus soils are in the higher valleys between the sandhills. They are well drained. Tryon and Marlake soils are lower on the landscape than the major soils and are poorly drained or very poorly drained. Blownout land is common in areas of the Valentine soils. It is mostly barren of vegetation and consists of loose fine sand.

Most of this association has a cover of native grasses and is used for grazing. Ranching is the main enterprise. Most of the ranchers raise feeder calves and yearlings. Only a few areas are used for hay because the valleys are too narrow for much more than an occasionally grown meadow crop. The association is better suited to native grasses than to most other uses. Where it is in good condition, the range supports mainly tall native grasses. The main concern in managing range is establishing a planned grazing system that includes proper grazing use. If the range is overgrazed, soil blowing is a hazard. The Els soils are best suited to hay because of subirrigation by the water table. High-yielding wells can be readily drilled for livestock and irrigation water.

Most of this association is unsuited to cultivated crops because of the slope. In a few small areas, the more gently sloping soils are used for irrigated crops. Corn and alfalfa are the main irrigated crops. Alfalfa is the principal dryland crop. Drought and soil blowing are management problems if cultivated crops are grown on the Valentine soils. Keeping crop residue on the surface and applying a system of conservation tillage help to control soil blowing and conserve moisture. The wetness of the Els soils is a problem. Measures that increase the organic matter content and the level of fertility are needed.

6. Coly-Uly Association

Deep, gently sloping to very steep, well drained to excessively drained, silty soils formed in loess; on uplands

This association consists of soils on ridges, side slopes, and hilltops along deeply entrenched drainageways. Slopes range from 3 to 60 percent.

The total area of this association is 8,969 acres, or about 2 percent of the county. The association is about 49 percent Coly soils, 24 percent Uly soils, and 27 percent minor soils (fig. 6).

The Coly soils are on narrow ridgetops and in strongly sloping to very steep areas on the sides of hills and canyons. These soils are well drained to excessively drained. Typically, the surface layer is grayish brown, very friable silt loam about 4 inches thick. The transition layer is pale brown, very friable silt loam about 8 inches thick. The underlying material to a depth of more than 60 inches is very pale brown, calcareous silt loam.

The Uly soils are on broad ridgetops and in gently sloping to moderately steep areas on hillsides. These soils are well drained and somewhat excessively drained. Typically, the surface layer is grayish brown, very friable silt loam about 7 inches thick. The subsoil is silt loam about 20 inches thick. The upper part is grayish brown and very friable, the next part is grayish brown and friable, and the lower part is brown, friable, and calcareous. The underlying material to a depth of more than 60 inches is pale brown, calcareous silt loam.

Minor in this association are the Gates, Hall, Hobbs, and Valentine soils. Gates soils are well drained and are nearly level to strongly sloping. They are on ridges and side slopes in the loess-sand transition areas. Hall soils are on the wide ridgetops. Hobbs soils are on narrow, occasionally flooded bottom land and in upland drainageways. Valentine soils are sandy throughout.

Farms in areas of this association are diversified. They are a combination of cash-grain and livestock enterprises. Some farmers fatten livestock for market. The steeper areas generally have a cover of native grasses and are used as range. The less sloping areas are cultivated. The main crops are corn, grain sorghum, and alfalfa. Most areas of the major Uly soils and the minor Hall soils are small and irregularly shaped. They are irrigated mainly by towline and gravity systems. A few areas are irrigated by center-pivot sprinkler systems.

Water erosion is the main hazard in the cultivated areas. Inadequate rainfall commonly limits the production of dryland crops. Also, measures that maintain fertility and control runoff are needed. The main concerns in managing range are regulating the degree of use and improving the range condition. Wells on the farms provide sufficient water for livestock and domestic uses.

7. Fluvaquents-Loup-Elsmere Association

Deep, nearly level, somewhat poorly drained to very poorly drained, sandy and loamy soils formed in sandy alluvium and mixed eolian and alluvial sands; on bottom land

This association consists of soils on bottom land along the Cedar River and Beaver Creek. These soils are subject to flooding and are frequently ponded.

The total area of this association is 3,300 acres, or about 1 percent of the county. The association is about 33 percent Fluvaquents, 28 percent Loup and similar soils, 14 percent Elsmere and similar soils, 15 percent minor soils, and 10 percent areas covered by water.

The Fluvaquents are very poorly drained and are frequently ponded by water from stream overflow and a very high water table. They are in the lowest position on the landscape, in oxbows and low lying areas bordering the larger streams. The seasonal high water table is 2 feet above the surface to 1 foot below in most years. Typically, the surface layer is dark gray, very friable loamy fine sand about 7 inches thick. The transition layer

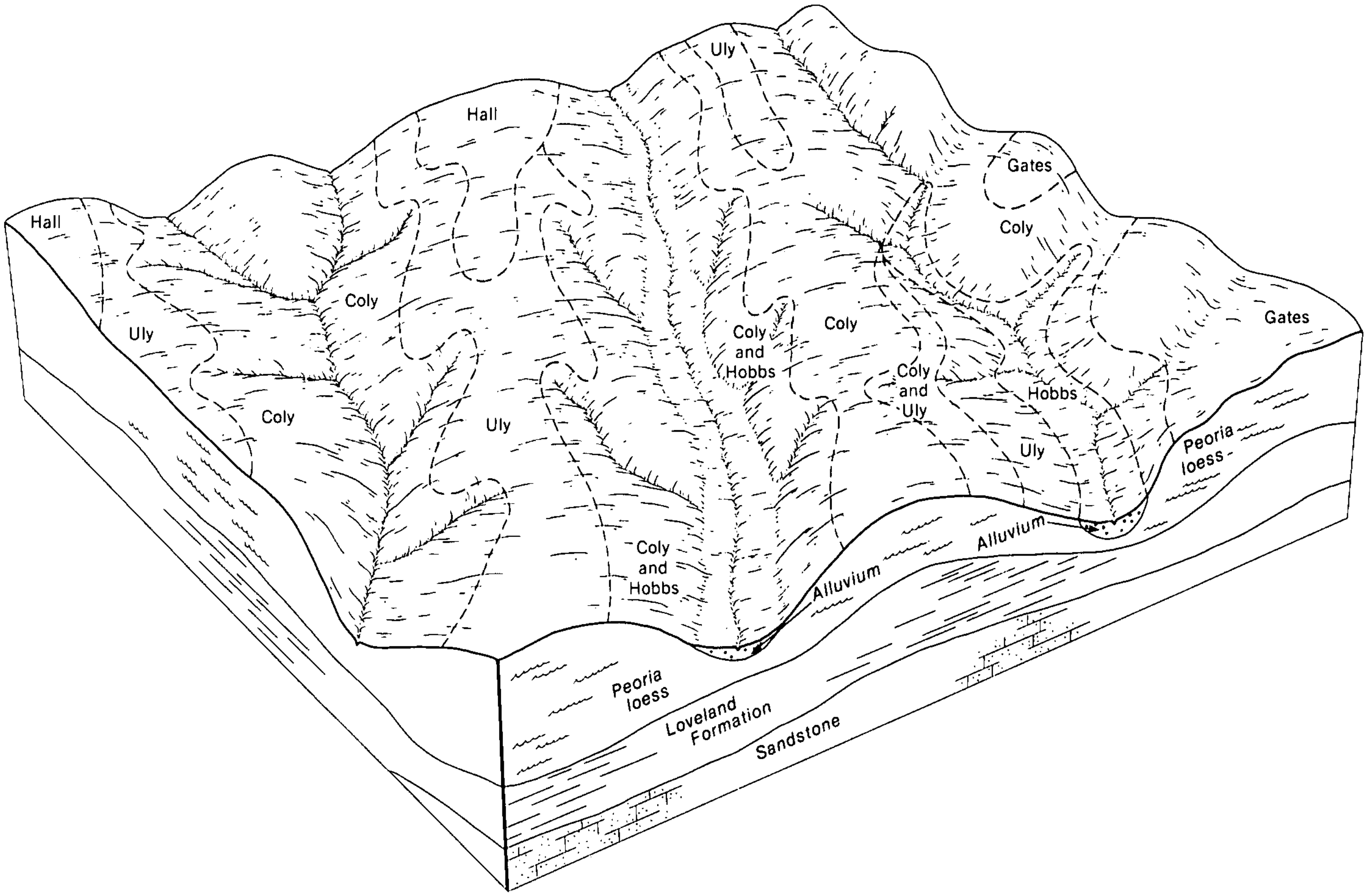

Figure 6.—Pattern of soils and parent material in the Coly-Uly association.

extends to a depth of about 22 inches. It is grayish brown, friable loamy sand stratified with black, loamy material. It has yellowish brown mottles. The underlying material to a depth of more than 60 inches is light brownish gray fine sand stratified with loamy sand.

The Loup soils are poorly drained and very poorly drained and are in the slightly higher positions on bottom land. They are subject to rare flooding and commonly are ponded by a very high water table. The seasonal high water table is about 0.5 foot above the surface in wet years and is within a depth of 1.5 feet in dry years. Typically, the surface layer is very dark gray, very friable fine sandy loam about 8 inches thick. The subsurface layer is very dark gray, friable loam about 6 inches thick. The transition layer is gray, loose loamy sand about 2 inches tick. The underlying material to a depth of about 60 inches is light gray fine sand. It has dark brown mottles at a depth of about 20 inches. In places the depth to the underlying material is less than 10 inches.

The Elsmere soils are higher on the bottom land than the Loup soils. They are somewhat poorly drained. The depth to the seasonal high water table ranges from about 1.5 feet in wet years to 3.0 feet in dry years. Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 12 inches thick. The subsurface layer is grayish brown, very friable loamy fine sand about 4 inches thick. The transition layer is light brownish gray, very friable loamy sand about 8 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand.

Minor in this association are the Inavale and Ipage soils. Inavale soils are somewhat excessively drained and are on the higher bottoms. Ipage soils are moderately well drained and are on stream terraces.

Most areas of this association have a cover of native vegetation and are used for range or wildlife habitat. The Fluvaquents are too wet for cultivated crops, hay, or range. They have a vegetative cover mainly of cattails, rushes, arrowhead, willow, and other water-tolerant

plants. They are suited primarily to wildlife habitat. The major Loup and Elsmere soils and the minor Inavale soils are used mainly for grazing and hay. Range management that includes proper grazing use and restricted grazing and haying during wet periods helps to maintain or improve the range condition. Wetness and flooding are problems on the Fluvaquents and the Loup soils.

Few farmsteads are in areas of this association because of the wetness and the flooding. Recreational cabins and facilities are common in areas adjoining this association.

8. Hobbs-Hord Association

Deep, nearly level and very gently sloping, well drained, silty soils formed in silty alluvium; on stream terraces, on bottom land, and in upland drainageways

The total area of this association is 1,460 acres, or less than 1 percent of the county. The association is about 68 percent Hobbs soils, 15 percent Hord soils, and 17 percent minor soils. Slopes of the major soils range from 0 to 3 percent.

The Hobbs soils are nearly level and are on bottom land and in upland drainageways. They are occasionally flooded for brief periods after heavy rains. Typically, the surface layer is grayish brown, very friable silt loam about 5 inches thick. The subsurface layer is grayish brown, friable silt loam about 2 inches thick. The underlying material to a depth of more than 60 inches is stratified grayish brown and light brownish gray silt loam and very fine sandy loam.

The Hord soils are very gently sloping and are on stream terraces. They are slightly higher on the landscape than the Hobbs soils. Typically, the surface layer is dark grayish brown, very friable silt loam about 5 inches thick. The subsurface layer also is dark grayish brown, very friable silt loam. It is about 17 inches thick. The subsoil is friable silt loam about 26 inches thick. It is grayish brown in the upper part, dark grayish brown in the next part, and brown in the lower part. The underlying material to a depth of more than 60 inches is pale brown silt loam.

Minor in this association are the Anselmo and Dunday soils on long, narrow ridges between drainageways. These soils are sandier throughout than the major soils.

This association is used mainly for cultivated crops. Many areas are irrigated. Most farms are diversified. They are a combination of cash-grain and livestock enterprises. Corn, soybeans, oats, and alfalfa are the main crops. Maintaining tilth and fertility is the main concern in managing the soils for dryland and irrigated crops. Water erosion is the main hazard in the very gently sloping areas.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Els loamy sand, 0 to 2 percent slopes, is a phase of the Els series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Elsmere-Ipage loamy fine sands, 0 to 3 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Blownout land is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Some of the soil boundaries and soil names on the detailed maps of this county do not fully match those on the maps of adjacent counties published at an earlier date. Differences result from changes and refinements in series concepts, variations in slope groupings, and application of the latest soil classification system.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

An—Anselmo fine sandy loam, 0 to 2 percent slopes. This deep, nearly level and very gently sloping, well drained soil is on uplands and stream terraces. It formed in loamy eolian material. Areas range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 5 inches thick. The subsurface layer is dark grayish brown, very friable fine sandy loam about 11 inches thick. The subsoil is very friable fine sandy loam about 12 inches thick. The upper part is brown, and the lower part is pale brown. The underlying material to a depth of more than 60 inches is pale brown loamy fine sand. In a few areas the surface layer is loamy fine sand or sandy loam. In some places the dark surface soil is more than 20 inches thick. In other places it is less than 7 inches thick. In some areas loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Boelus, Dunday, and Valentine soils. Boelus soils have silty and loamy material below a depth of 20 inches. They are in landscape positions similar to those of the Anselmo soil. Dunday and Valentine soils are higher on the landscape than the Anselmo soil. Also, they are sandier throughout. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the Anselmo soil, and the available water capacity is moderate. Organic matter content is moderately low. The water intake rate is moderately high. Runoff is slow. The soil can be easily tilled throughout a wide range of moisture content.

This soil is used mainly for cultivated crops. Some small areas support native grasses and are used as range.

If used for dryland farming, this soil is suited to corn, alfalfa, small grain, and introduced grasses. The hazard of soil blowing can be reduced and moisture conserved by stubble mulch tillage, stripcropping, and a cropping system that maintains a protective cover of grass or crop residue. A cropping system that includes legumes, grasses, or a mixture of both increases the organic matter content and helps to maintain fertility and control soil blowing. Row crops can be alternated with small grain and legumes in the crop rotation.

If irrigated, this soil is suited to corn, alfalfa, small grain, and introduced grasses. Some land grading is necessary when a site is prepared for gravity irrigation. A sprinkler system is generally the most practical method of irrigation because land leveling is not required and because frequent, light applications of water are needed. One large application can leach plant nutrients below the root zone. Returning crop residue to the soil and keeping tillage to a minimum by applying a system of conservation tillage, such as chiseling, disking, or till-planting, help to control erosion and maintain fertility. Growing crops or leaving crop residue on the surface in winter helps to control soil blowing. Adding barnyard manure increases the organic matter content and improves fertility.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by sand bluestem, prairie sandreed, little bluestem, needleandthread, and blue grama. These species make up 70 percent or more of the total annual production. Sand dropseed, indiangrass, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, blue grama, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing or haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to range if a proper seedbed is prepared and a suitable cover crop is grown for 2 or more years. A suitable mixture of native grass seed should be selected.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to some of the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand somewhat droughty conditions. A scarcity of moisture and the hazard of soil blowing are the principal concerns in establishing trees. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Cultivation generally should be restricted to the tree rows. Irrigation is needed during dry periods. Weeds and undesirable grasses in the tree rows can be controlled by applying appropriate herbicides or by hand hoeing or rototilling.

This soil is suitable as a site for septic tank absorption fields and dwellings. Seepage is a hazard on sites for sewage lagoons. It can be controlled by lining or sealing the lagoon. The sides of shallow excavations can cave in unless they are temporarily shored. The damage to local roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIe-3, dryland, and IIe-8, irrigated; Sandy range site; windbreak suitability group 5.

AnC—Anselmo fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. It formed in loamy eolian material. Areas range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 5 inches thick. The subsurface layer is dark grayish brown fine sandy loam about 7 inches thick. The subsoil is very friable fine sandy loam about 17 inches thick. The upper part is brown, and the lower part is light yellowish brown. The underlying material to a depth of more than 60 inches is light yellowish brown loamy fine sand. In places the surface layer is loamy sand or loam. In some areas the dark surface soil is more than 20 inches thick. In other areas it is less than 7 inches thick. In some places strata of loamy material are within a depth of 60 inches. In other places severe soil blowing or water erosion has exposed the brown subsoil or the sandy underlying material.

Included with this soil in mapping are small areas of Boelus, Dunday, and Valentine soils. Boelus soils are lower on the landscape than the Anselmo soil. They are underlain by silty and loamy material. Dunday and Valentine soils are sandier throughout than the Anselmo soil. Also, they are higher on the landscape. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the Anselmo soil, and the available water capacity is moderate. Organic matter content is moderately low. The water intake rate is moderately high. Runoff is slow or medium. The soil can be easily tilled throughout a wide range of moisture content.

Some areas of this soil are used for cultivated crops. The rest support native grasses and are used as range.

If used for dryland farming, this soil is suited to corn, alfalfa, small grain, and soybeans. Water erosion and soil blowing are the main hazards. They can be controlled by stubble mulch tillage and a cropping system that maintains a protective cover of crops or crop residue. A cropping system that includes legumes, grasses, or a mixture of both increases the organic matter content and helps to maintain fertility. Row crops can be alternated with small grain and legumes in the crop rotation.

If irrigated, this soil is suited to corn, alfalfa, soybeans, small grain, and introduced grasses. A sprinkler system is the most practical method of irrigation because of the slope. Careful management of the water applications helps to prevent the leaching of plant nutrients below the root zone. Returning crop residue to the soil and keeping tillage to a minimum help to control erosion and maintain fertility. Growing cover crops or leaving crop residue on the surface in winter helps to control erosion and soil blowing. Adding barnyard manure increases the organic matter content and improves fertility.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by sand bluestem, prairie sandreed, little bluestem, needleandthread, and blue grama. These species make up 70 percent or more of the total annual production. Sand dropseed, indiangrass, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, bluegrass, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing or haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with steeper soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to range if a proper seedbed is prepared and a suitable cover crop is grown for 2 or more years. A suitable mixture of native grass seed should be selected.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to some of the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand somewhat droughty conditions. Irrigation is needed during dry periods. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the tree rows. Weeds and grasses can be controlled by cultivating with conventional equipment in the tree rows.

This soil is suitable as a site for septic tank absorption fields and dwellings. Seepage is a hazard on sites for sewage lagoons. It can be controlled by lining or sealing the lagoon. The sides of shallow excavations can cave in unless they are temporarily shored. The damage to local roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIIe-3, dryland, and IIIe-8, irrigated; Sandy range site; windbreak suitability group 5.

Bg—Blownout land-Valentine complex, 6 to 60 percent slopes. This map unit is in the sandhills. The Blownout land occurs mainly as bare areas in bowllike depressions that have been hollowed out by the wind (fig. 7). The depressions are 5 to more than 50 feet deep. Many are eroded down to a permanent water table. The deep, excessively drained Valentine soil is adjacent to the depressions. It formed in windblown sandy material. Areas of this unit range from 5 to 200 acres in size. They are 50 to 80 percent Blownout land and 20 to 50 percent Valentine soil. The Blownout land and Valentine soil occur as areas so intricately mixed that separating them in mapping is not practical.

The Blownout land is light brownish gray to very pale brown, loose fine sand that is easily shifted by the wind.

Typically, the Valentine soil has a surface layer of grayish brown, very friable fine sand about 4 inches thick. The transition layer is light brownish gray, loose fine sand about 4 inches thick. The underlying material to a depth of more than 60 inches is very pale brown, loose fine sand. In many places the upper 2 to 12 inches is light brownish gray to very pale brown, loose sand.

Included in this unit in mapping are small areas of the somewhat poorly drained Els, poorly drained and very poorly drained Tryon, and very poorly drained Marlake soils at the bottom of blowouts where the water table is exposed. Included soils make up 5 to 15 percent of some mapped areas.

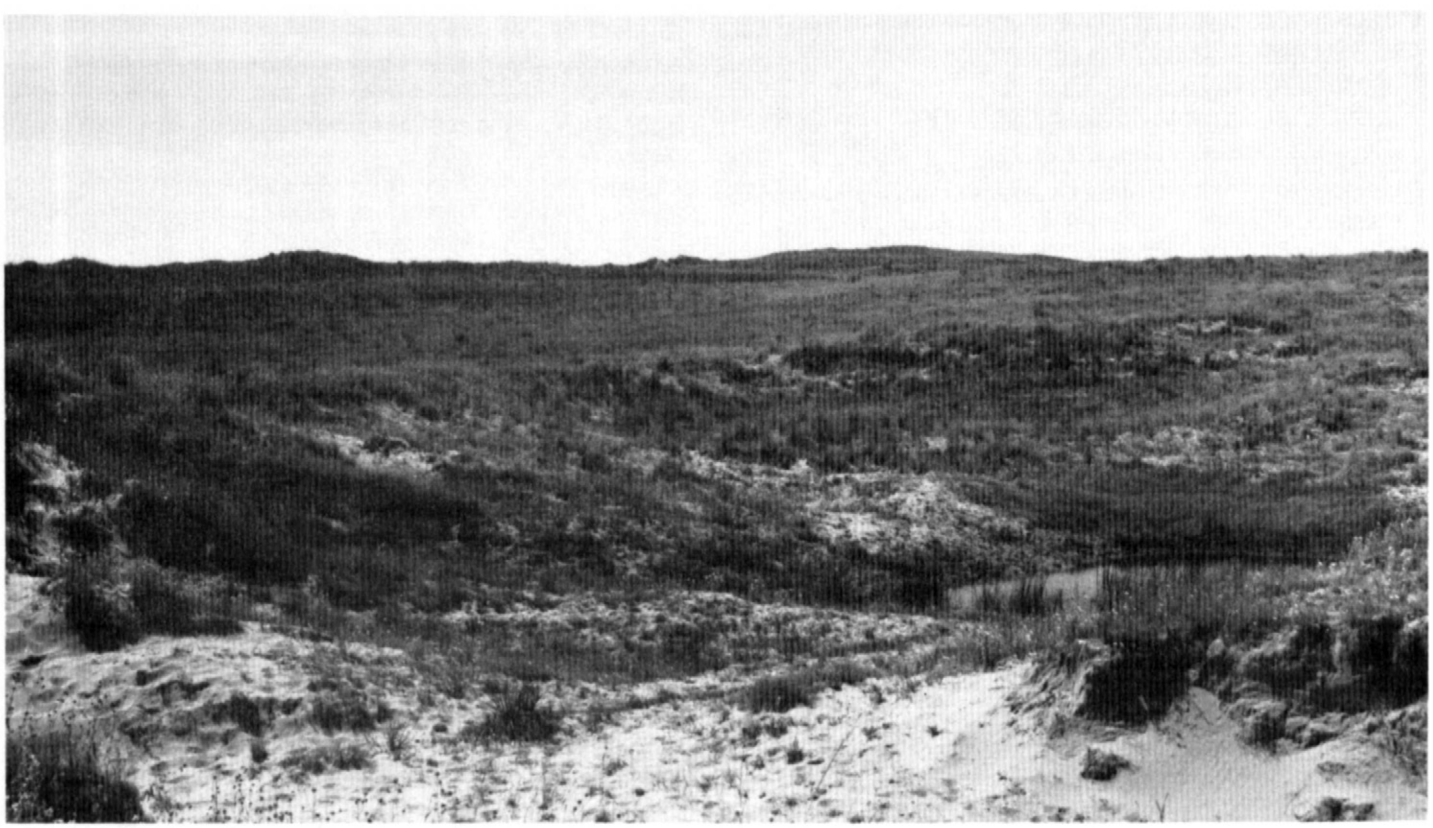

Figure 7.—An area of the Blownout land-Valentine complex, 6 to 60 percent slopes. Blownout land is in bowllike depressions.

Permeability is rapid in the Valentine soil. The available water capacity and organic matter content are low. Runoff is slow.

This unit is unsuitable as cropland. Unstabilized areas of Blownout land support little or no vegetation and are not grazed. The climax vegetation on the Valentine soil is dominated by sand bluestem, little bluestem, prairie sandreed, needleandthread, and switchgrass. These species make up 75 percent or more of the total annual production on this soil. Sand lovegrass, blue grama, blowout grass, and sandhill muhly make up the rest. If subject to continuous heavy grazing, the native plants on the Valentine soil lose vigor and are unable to stabilize the site. As a result, the susceptibility to soil blowing is increased and the areas of Blownout land are enlarged.

Before this unit can regain its productive capacity, the Blownout land should be stabilized and native grass reestablished. Most areas of Blownout land can be reclaimed in 4 or 5 years if a planned grazing system is used to control trampling and grazing by livestock. Shaping the steep banks to a stable grade and controlling use through a planned grazing system stabilize this land and allow vegetation to become established. Shaping the banks helps to control soil blowing during revegetation. If fences keep livestock away from blowouts, shaping, seeding, and mulching the blowouts can hasten reclamation.

The potential stocking rate on this unit varies, depending on the size and distribution of blowouts and the amount of vegetation on the blowouts. Onsite evaluation is needed to determine the potential stocking rate. Locating watering or salting facilities in the adjacent areas helps to prevent excessive trampling on this unit. Excessive trampling can enlarge the areas of Blowout land.

After grasses are reestablished, properly managing this unit as range is very effective in controlling further erosion. Overgrazing can reactivate the Blownout land. A planned grazing system that includes proper grazing use, timely deferment of grazing, and the use of fences to control grazing helps to maintain or improve the range condition in stabilized areas.

This unit is unsuited to the trees grown as windbreaks. The sand in the areas of Blownout land is loose. Young seedlings can be damaged by windblown sand. The Valentine soil can be used for some of the trees and shrubs that enhance recreational areas or wildlife habitat and for forestation plantings, but hand planting or other special management is needed.

This unit generally is not suitable as a site for sanitary facilities or buildings. A suitable alternative site is needed.

The land capability unit is VIe-5, dryland; windbreak suitability group 10. The Valentine soil is assigned to the Sands range site, and the Blowout land is not assigned to a range site.

BsB—Boelus loamy sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, well drained soil is on uplands. It formed in sandy eolian material over loamy and silty sediments. Individual areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 6 inches thick. The subsurface layer is about 16 inches thick. It is dark grayish brown, very friable loamy fine sand in the upper part and pale brown, loose fine sand in the lower part. The subsoil is yellowish brown, firm sandy clay loam about 12 inches thick. The underlying material to a depth of more than 60 inches is light yellowish brown silt loam. In some places the surface layer is less than 10 inches thick, and in other places it is sandy loam or sand. In some areas the sandy material is less than 20 or more than 36 inches deep over loamy material.

Included with this soil in mapping are small areas of Anselmo, Dunday, Ipage, Loretto, and Valentine soils. Anselmo and Loretto soils are lower on the landscape than the Boelus soil. They are not underlain by loamy and silty material. Dunday and Valentine soils are higher on the landscape than the Boelus soil. They are sandy throughout. Ipage soils are in positions on the landscape similar to those of the Boelus soil. They are moderately well drained. Also included are areas where the loamy material is exposed. Included soils make up 10 to 15 percent of the unit.

The Boelus soil is rapidly permeable in the sandy material and moderately permeable in the silty or loamy underlying material. The available water capacity is high. Organic matter content is moderately low. The water intake rate is high. Runoff is slow. The soil can be easily tilled when moist or dry.

Most of the acreage of this soil is farmed. The rest supports native grasses. A large acreage is irrigated.

If used for dryland farming, this soil is suited to corn, small grain, and alfalfa. Small grain and the first cutting of alfalfa are generally the most dependable crops because they grow and mature in spring, when rainfall is plentiful. The soil is highly susceptible to soil blowing. A cropping system that maintains a protective cover of crop residue helps to control soil blowing, conserves moisture, and helps to maintain the organic matter content and fertility. Adding barnyard manure increases the organic matter content and improves fertility. After periods of very heavy rainfall, some areas are ponded by runoff from the surrounding higher areas. The ponding can damage crops.

If irrigated, this soil is suited to corn, soybeans, alfalfa, and introduced grasses. A sprinkler system is the best method of irrigation because frequent, light applications of water are needed. Returning crop residue to the soil increases the organic matter content. A protective cover of crops, grasses, or crop residue reduces the susceptibility to soil blowing and conserves moisture.

This soil is suited to introduced grasses for pasture or hay. Cool-season grasses, such as smooth brome, orchardgrass, and tall fescue, can be grown in a mixture with alfalfa. Forage production can be increased or maintained by proper stocking rates and rotation grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by little bluestem, needleandthread, prairie sandreed, blue grama, and sand bluestem. These species make up 70 percent or more of the total annual production. Sand dropseed, indiangrass, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, blue grama, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing or haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with Valentine fine sand, rolling, or Valentine fine sand, rolling and hilly. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to a suitable grass mixture if a proper seedbed is prepared and a suitable cover crop is grown for 2 years.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to some of the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand somewhat droughty conditions. A scarcity of moisture and a severe hazard of soil blowing are the principal concerns in establishing trees. Irrigation is needed during dry periods. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the tree rows. Weeds compete with the trees for moisture. They can be controlled by cultivation or by appropriate herbicides.

This soil is suitable as a site for septic tank absorption fields and shallow excavations. Seepage is a hazard on sites for sewage lagoons. It can be controlled by lining or sealing the lagoon. The shrink-swell potential is a limitation on sites for dwellings. Strengthening foundations and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil. Providing coarser grained subgrade or base material helps to ensure better performance.

The land capability units are IIIe-6, dryland, and IIIe-10, irrigated; Sandy range site; windbreak suitability group 5.

BsC—Boelus loamy sand, 3 to 6 percent slopes. This deep, gently sloping, well drained soil generally is on convex side slopes in the uplands. It formed in sandy eolian material over loamy and silty sediments. Areas range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable loamy sand about 6 inches thick. The subsurface layer is dark grayish brown and brown, very friable loamy sand about 18 inches thick. The subsoil is brown, firm silt loam about 6 inches thick. The underlying material to a depth of more than 60 inches is light yellowish brown silt loam. In some places the surface layer is less than 10 inches thick. In other places it is sand or sandy loam. In some areas the sandy material is less than 20 or more than 36 inches deep over loamy material.

Included with this soil in mapping are small areas of Anselmo, Dunday, and Valentine soils. Anselmo soils generally are not underlain by loamy material. They are lower on the landscape than the Boelus soil. Dunday and Valentine soils are higher on the landscape than the Boelus soil. Also, they are sandier throughout. Also included are some areas where loamy material is exposed and some areas where weathered sandstone is in the lower part of the profile. Included soils make up 10 to 15 percent of the unit.

The Boelus soil is rapidly permeable in the sandy material and moderately permeable in the loamy or silty material. The available water capacity is high. Organic matter content is moderately low. The water intake rate is high. Runoff is slow or medium. The soil can be easily worked throughout a wide range of moisture content.

Most of the acreage of this soil is farmed. The rest supports native grasses.

If used for dryland farming, this soil is suited to corn, sorghum, small grain, and alfalfa. Small grain and the first cutting of alfalfa are generally the most dependable crops because they grow and mature in spring, when the amount of rainfall is usually highest. The soil is highly susceptible to soil blowing and water erosion. A cropping system that maintains a protective cover of crop residue helps to control soil blowing and water erosion and conserves moisture. Adding barnyard manure increases the organic matter content and improves fertility.

If irrigated, this soil is suited to corn, soybeans, alfalfa, and introduced grasses. A sprinkler system is the best method of irrigation because frequent, light applications of water are needed. One large application can leach plant nutrients below the root zone. Soil blowing and water erosion can be controlled by a cropping system that maintains a protective cover of close-growing crops, grasses, or crop residue. All crop residue should be returned to the soil.

This soil is suited to grasses for pasture and hay. Cool-season grasses, such as smooth brome, orchardgrass, and tall fescue, can be grown in a mixture with alfalfa. Forage production can be increased or maintained by proper stocking rates and rotation grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by little bluestem, needleandthread, prairie sandreed, blue grama, and sand bluestem. These species make up 70 percent or more of the total annual production. Sand dropseed, indiangrass, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, blue grama, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing or haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with steeper soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to a suitable grass mixture if a proper seedbed is prepared and a suitable cover crop is grown for 2 years.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to some of the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand somewhat droughty conditions. A scarcity of moisture and a severe hazard of soil blowing are the principal concerns in establishing trees. Irrigation is needed during dry periods. Soil blowing and water erosion can be controlled by maintaining strips of sod or other vegetation between the tree rows. Weeds compete with the trees for moisture. They can be controlled by cultivation or by appropriate herbicides.

This soil is suitable as a site for septic tank absorption fields and shallow excavations. The slope is a limitation on sites for sewage lagoons. Grading can modify the slope and shape the lagoon. The shrink-swell potential is a limitation on sites for dwellings. Strengthening foundations and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling. Local roads should be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil. Providing coarse grained subgrade or base material helps to ensure better performance.

The land capability units are IVe-6, dryland, and IIIe-10, irrigated; Sandy range site; windbreak suitability group 5.

CoD2—Coly silt loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil is on narrow ridges and the upper parts of side slopes in the uplands. It formed in calcareous loess. In places, water erosion has removed most of the darkened surface layer and rills and gullies have exposed the underlying material. Areas range from 5 to 50 acres in size.

Typically, the surface layer is grayish brown, very friable, calcareous silt loam about 5 inches thick. The transition layer is pale brown, very friable, calcareous silt loam about 7 inches thick. The underlying material to a

depth of more than 60 inches is very pale brown, calcareous silt loam. In places the depth to carbonates is more than 10 inches. In some areas windblown fine sand or loamy fine sand has been deposited on the surface.

Included with this soil in mapping are small areas of Uly and Hall soils. Uly soils are on the lower side slopes. Their surface layer is thicker than that of the Coly soil. Hall soils are on the broader ridgetops. They have more clay in the subsoil than the Coly soil. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Coly soil, and the available water capacity is high. Organic matter content is moderately low. The water intake rate is moderate. Runoff is medium.

Much of the acreage of this soil supports native grasses and is used as range. A few areas are used for dryland or irrigated crops.

If used for dryland farming, this soil is poorly suited to corn and sorghum. It is better suited to small grain and alfalfa. Water erosion is the principal hazard. It can be controlled by terraces, contour farming, and a system of conservation tillage that leaves crop residue on the surface. Returning crop residue to the soil and applying barnyard manure help to maintain or increase the organic matter content and the level of fertility.

If irrigated, this soil is poorly suited to alfalfa, sorghum, introduced grasses, and corn. A sprinkler system is the best method of irrigation. Terraces, contour farming, conservation tillage, and close-grown crops, such as alfalfa and grasses, help to control water erosion. Returning crop residue to the soil increases the organic matter content and improves fertility. If a center-pivot irrigation system is used, erosion can occur in the wheel tracks and small gullies can form. Adjusting the application rate to the moderate water intake rate of the soil permits most of the water to penetrate the surface and reduces the amount that runs off the surface.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and intermediate wheatgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa. Warm-season grasses, such as switchgrass, also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by little bluestem, big bluestem, sideoats grama, western wheatgrass, and blue grama. These species make up 70 percent or more of the total annual production. Indiangrass, needleandthread, plains muhly, buffalograss, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem and little bluestem decrease in abundance. Initially, these species are replaced by hairy grama, prairie sandreed, tall dropseed, western wheatgrass, needleandthread, plains muhly, sedges, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. Under these conditions, the amount of soil lost through water erosion and soil blowing increases.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing or haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture. In areas where gullies have formed because of severe water erosion, both land shaping and deferred grazing may be required to stabilize the site.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to farmstead and feedlot windbreaks and to the trees and shrubs that enhance recreational areas and wildlife habitat. It is only fairly well suited to field windbreaks. A high content of calcium and competition from grasses and weeds are the principal concerns in establishing and maintaining the trees and shrubs. Water erosion also is a concern. Irrigation is needed during dry periods. The species selected for planting should be those that can grow well in a limy soil. Planting on the contour and terracing conserve moisture. Cultivation or applications of approved herbicide control weeds.

The slope is a limitation if this soil is used as a site for sanitary facilities, dwellings, or local roads. Land shaping and installing the distribution lines on the contour help to ensure that septic tank absorption fields function properly. On sites for sewage lagoons, extensive grading is needed to modify the slope. Also, lining or sealing the lagoon helps to prevent seepage. Dwellings should be

designed so that they conform to the natural slope of the land. In some areas land shaping is needed. Cutting and filling help to establish a suitable grade for roads. The road damage caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IVe-9, dryland, and IVe-6, irrigated; Limy Upland range site; windbreak suitability group 8.

CoF—Coly silt loam, 17 to 30 percent slopes. This deep, steep, somewhat excessively drained soil is on side slopes and ridges adjacent to upland drainageways. It formed in calcareous loess. Areas range from 10 to 200 acres in size.

Typically, the surface layer is grayish brown, very friable, calcareous silt loam about 4 inches thick. The transition layer is pale brown, very friable, calcareous silt loam about 7 inches thick. The underlying material to a depth of more than 60 inches is very pale brown, calcareous silt loam. In places the depth to carbonates is more than 10 inches.

Included with this soil in mapping are small areas of Hall, Hobbs, Uly, and Valentine soils. Hall soils are in the less sloping areas on broad ridgetops. They contain more clay in the subsoil than the Coly soil. Hobbs soils are in narrow drainageways and are occasionally flooded. They are darker than the Coly soil and are deeper to lime. Uly soils are on the lower side slopes or in landscape positions similar to those of the Coly soil. Their surface layer is thicker than that of the Coly soil. Valentine soils are on the upper side slopes near the head of drainageways. They contain more sand than the Coly soil. Included soils make up less than 15 percent of the unit.

The Coly soil is moderately permeable and has a high available water capacity. It releases water readily to plants. Runoff is rapid. Organic matter content is moderately low.

Almost all of the acreage is range used for grazing or hay. Some small areas are cultivated along with areas of less sloping soils. This soil is generally unsuited to dryland and irrigated crops because of the slope and a severe hazard of water erosion.

If this soil is used for range, the climax vegetation is dominated by little bluestem, big bluestem, sideoats grama, western wheatgrass, and blue grama. These species make up 70 percent or more of the total annual production. Indiangrass, needleandthread, plains muhly, buffalograss, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem and little bluestem decrease in abundance. Initially, these species are replaced by hairy grama, prairie sandreed, tall dropseed, western wheatgrass, needleandthread, plains muhly, sedges, annual grasses, and forbs. If overgrazing continues for many years, native grasses lose vigor and are unable to stabilize the site. Under these conditions, the amount of soil lost through water erosion and soil blowing increases.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing or haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture. In areas where gullies have formed because of severe water erosion, both land shaping and deferred grazing may be needed to stabilize the site.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. Some areas can be used for the trees and shrubs that enhance wildlife habitat and for forestation plantings if special management measures, such as hand planting, are applied and if the species selected for planting are those that can grow well in a limy soil. Water erosion is a major management concern.

This soil is not suitable as a site for septic tank absorption fields or sewage lagoons because of the slope. An alternative site should be selected. Dwellings should be designed so that they conform to the natural slope of the land. In some areas land shaping is needed. On sites for local roads and streets, cutting and filling can establish a suitable grade. The road damage caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability unit is VIe-9, dryland; Limy Upland range site; windbreak suitability group 10.

CpG—Coly-Hobbs silt loams, 2 to 60 percent slopes. These deep, very gently sloping to very steep soils are on deeply dissected uplands that have narrow bottoms. They commonly are at the upper end of drainageways, but some areas are in canyons as much as 1 mile long. The excessively drained, very steep Coly soil is on canyon sides and on narrow ridges between the canyons. The canyon sides commonly have a succession of short, vertical exposures, called "catsteps." The well drained, very gently sloping Hobbs soil is on narrow bottom land below the canyon sides. It is occasionally flooded for brief periods. The Coly soil formed in calcareous loess, and the Hobbs soil formed in silty alluvium. Areas range from 20 to 300 acres in size. They are 65 to 70 percent Coly soil and 15 to 20 percent Hobbs soil. The two soils occur as areas so small or so narrow that separating them in mapping is not practical.

Typically, the Coly soil has a surface layer of brown, very friable, calcareous silt loam about 4 inches thick. The transition layer is pale brown, very friable, calcareous silt loam about 8 inches thick. The underlying material to a depth of more than 60 inches is very pale brown, calcareous silt loam. In some places windblown fine sand or loamy fine sand has been deposited on the surface. In other places the depth to carbonates is more than 10 inches. In some areas the canyon sides are nearly vertical.

Typically, the Hobbs soil has a surface layer of grayish brown, friable silt loam about 6 inches thick. The underlying material to a depth of more than 60 inches is silt loam. It is brown and dark grayish brown in the upper part and pale brown in the lower part. In some areas the surface layer is stratified. In other areas the soil has strata of sandy and loamy material. In places carbonates are within 10 inches of the surface.

Included with these soils in mapping are small areas of Uly and Valentine soils. Uly soils are on the lower side slopes. Their surface layer is thicker than that of the Coly and Hobbs soils. Valentine soils generally are on the upper side slopes and on ridgetops. They contain more sand than the Coly and Hobbs soils. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Coly and Hobbs soils, and the available water capacity is high. Organic matter content is moderately low in the Coly soil and moderate in the Hobbs soil. Runoff is very rapid on the Coly soil and slow on the Hobbs soil.

Almost all of the acreage supports native grasses and is used for grazing and wildlife habitat. A few narrow strips of the Hobbs soil are farmed. These soils are generally unsuited to cultivated crops, pasture, and hay because of the slope. They are well suited to range. A cover of range plants is effective in controlling water erosion and soil blowing.

The very gently sloping Hobbs soil is easily accessible to livestock and thus tends to be overgrazed. The natural plant community on this soil is dominantly big bluestem, western wheatgrass, little bluestem, switchgrass, and blue grama. These species make up 60 percent or more of the total annual production on this soil. Prairie junegrass, green needlegrass, Kentucky bluegrass, other perennial and annual grasses, forbs, sedges, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and green needlegrass decrease in abundance. Initially, these species are replaced by western wheatgrass, Kentucky bluegrass, and various sedges. If the surrounding areas are so overgrazed that the protective plant cover is seriously depleted, this soil is frequently or occasionally ponded by runoff for brief periods. The ponding results in sedimentation and channeling.

The very steep Coly soil is not easily accessible to livestock. The climax vegetation is dominated by little bluestem, big bluestem, and sideoats grama. These species make up more than 55 percent of the total annual production on this soil. Blue grama, hairy grama, indiangrass, plains muhly, prairie sandreed, sedges, and numerous forbs and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, and sideoats grama decrease in abundance. Initially, these species are replaced by blue grama, hairy grama, plains muhly, prairie sandreed, needleandthread, and numerous annual grasses and forbs. If overgrazing continues for many years, tall dropseed, Scribner panicum, and numerous annual and perennial weeds dominate the site. If the range deteriorates further, the plant community loses vigor and is not able to stabilize the site. Under these conditions, excessive water erosion and soil blowing occur.

If the range is in excellent condition, the suggested initial stocking rate is 1.2 animal unit months per acre on the Hobbs soil and is 0.6 animal unit month per acre on the Coly soil. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Achieving a good distribution of grazing is difficult on these soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse. The extent of small soapweed increases in areas that are grazed only in summer. As a result, these areas should be used as winter range.

These soils generally are unsuited to windbreaks. Some of the trees and shrubs that enhance recreational areas and wildlife habitat and some forestation plantings can be grown if special management measures, such as hand planting, are applied. The species selected for planting should be those that can grow well in a limy soil.

These soils generally are not suitable as sites for sanitary facilities or buildings because of the slope of the Coly soil and the flooding on the Hobbs soil. A suitable alternative site is needed. Cutting and filling help to establish a suitable grade for local roads on the Coly soil. Providing coarse grained base material helps to ensure better performance. Constructing the roads on suitable, well compacted fill material above the level of flooding and providing adequate side ditches and culverts help to prevent the road damage caused by floodwater on the Hobbs soil.

The land capability unit is VIIe-9, dryland; windbreak suitability group 10. The Coly soil is in the Thin Loess range site, and the Hobbs soil is in the Silty Overflow range site.

CuE2—Coly-Uly silt loams, 11 to 17 percent slopes, eroded. These deep, moderately steep, somewhat excessively drained soils are on side slopes and narrow ridgetops in the uplands. The Coly soil commonly is on the higher and steeper convex ridgetops, and the Uly soil is on the lower parts of the side slopes and in concave areas. Both soils formed in loess. Much of the original surface layer has been removed by erosion. Areas are 45 to 65 percent Coly soil and 20 to 45 percent Uly soil. The two soils occur as areas so intricately mixed or so small that separating them in mapping is not practical.

Typically, the Coly soil has a surface layer of grayish brown, very friable, calcareous silt loam about 5 inches thick. The transition layer is pale brown, very friable, calcareous silt loam about 9 inches thick. The underlying material to a depth of more than 60 inches is very pale brown, calcareous silt loam. In places the depth to carbonates is more than 10 inches.

Typically, the Uly soil has a surface layer of grayish brown, very friable silt loam about 6 inches thick. The subsoil is friable silt loam about 10 inches thick. It is brown in the upper part and pale brown and calcareous in the lower part. The underlying material to a depth of 60 inches or more is pale brown and very pale brown, calcareous silt loam. In places the surface layer is less than 7 inches thick. In a few areas the subsoil is silty clay loam.

Included with these soils in mapping are small areas of the very gently sloping Hall soils on ridgetops. These included soils have more clay in the subsoil than the Coly and Uly soils. They make up 5 to 15 percent of the unit.

Permeability is moderate in the Coly and Uly soils, and the available water capacity is high. Organic matter content is moderately low. Runoff is rapid. Tilth is good.

Most areas have been reseeded to native grasses and are used as range. A small acreage is used for cultivated crops. These soils are generally unsuited to dryland and irrigated crops because of a very severe hazard of water erosion. They are better suited to native grasses.

If these soils are used as range, the climax vegetation is dominated by big bluestem, blue grama, little bluestem, sideoats grama, switchgrass, and western wheatgrass. These species make up 70 percent or more of the total annual production. Buffalograss, needleandthread, prairie junegrass, Scribner panicum, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance. Initially, these species are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. Under these conditions, excessive water erosion and soil blowing occur.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Coly soil and is 0.9 animal unit month per acre on the Uly soil. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering facilities, roads, and trails. The areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture. In areas where gullies have formed because of severe water erosion, land shaping and deferred grazing may be needed to stabilize the site.

If these soils are used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

These soils are suited to the trees and shrubs grown as windbreaks. A high content of calcium and competition from grasses and weeds are the main management concerns. Also, water erosion is a hazard. It can be controlled by planting on the contour and terracing. Undesirable grasses and weeds can be removed by cultivation or by applications of appropriate herbicide. Removing these plants conserves soil moisture.

The slope is a limitation if these soils are used as sites for dwellings or sanitary facilities. Land shaping may be needed on sites for septic tank absorption fields. Also, the absorption fields should be installed on the contour. Sewage lagoons should be constructed on a less steep alternative site. Dwellings should be designed so that they conform to the natural slope of the land. Also, the site can be graded to an acceptable gradient.

Local roads should be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the Uly soil. Providing coarse grained subgrade or base material helps to ensure better performance. The road damage caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability unit is VIe-9, dryland. The Coly soil is in the Limy Upland range site and in windbreak suitability group 8. The Uly soil is in the Silty range site and in windbreak suitability group 3.

DuB—Dunday loamy fine sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, well drained soil is on uplands and stream terraces. It formed in sandy eolian material. Areas range from 5 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 10 inches thick. The subsurface layer is grayish brown, very friable loamy fine sand about 5 inches thick. The transition layer is grayish brown, very friable loamy sand about 7 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand. In some places the upper part of the surface layer is sand or fine sand. In other places the dark color of the surface layer extends to a depth of less than 10 or more than 20 inches. In a few areas loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Boelus, Ipage, and Valentine soils. Boelus and Ipage soils are in the lower landscape positions. Boelus soils have silty and loamy underlying material. Ipage soils have mottles at a depth of 20 to 40 inches. Valentine soils are in the higher landscape positions. Their surface layer is thinner than that of the Dunday soil. Also included are small areas where the slope is more than 3 percent. Included soils make up 10 to 15 percent of the unit.

The Dunday soil is rapidly permeable and has a low available water capacity. Organic matter content is moderately low. The water intake rate is very high. Runoff is slow. The soil can be easily worked throughout a wide range of moisture content.

A large acreage of this soil is farmed. The rest supports native grasses and is used as range. Many of the farmed areas are irrigated.

If used for dryland farming, this soil is poorly suited to corn, sorghum, alfalfa, small grain, and introduced grasses. Soil blowing is a serious hazard. It can be controlled by maintaining a cover of crop residue throughout the winter, by applying a conservation tillage system of planting, and by planting a winter cover crop of rye and vetch in the fall. Stripcropping and field windbreaks also help to control soil blowing. The low available water capacity is a limitation.

If irrigated, this soil is suited to corn, soybeans, alfalfa, and introduced grasses. A sprinkler system is the only suitable method of irrigation (fig. 8). Applications of water should be light and frequent because the water from one large application can leach plant nutrients below the root zone. Soil blowing is a severe hazard in cultivated areas. A cropping system that maintains a cover of crops, grasses, or crop residue helps to control soil blowing and conserves moisture. All crop residue should be left on the surface throughout the winter.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual production. Blue grama, sand dropseed, indiangrass, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, bluegrass, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with Sands or Choppy Sands range sites. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of

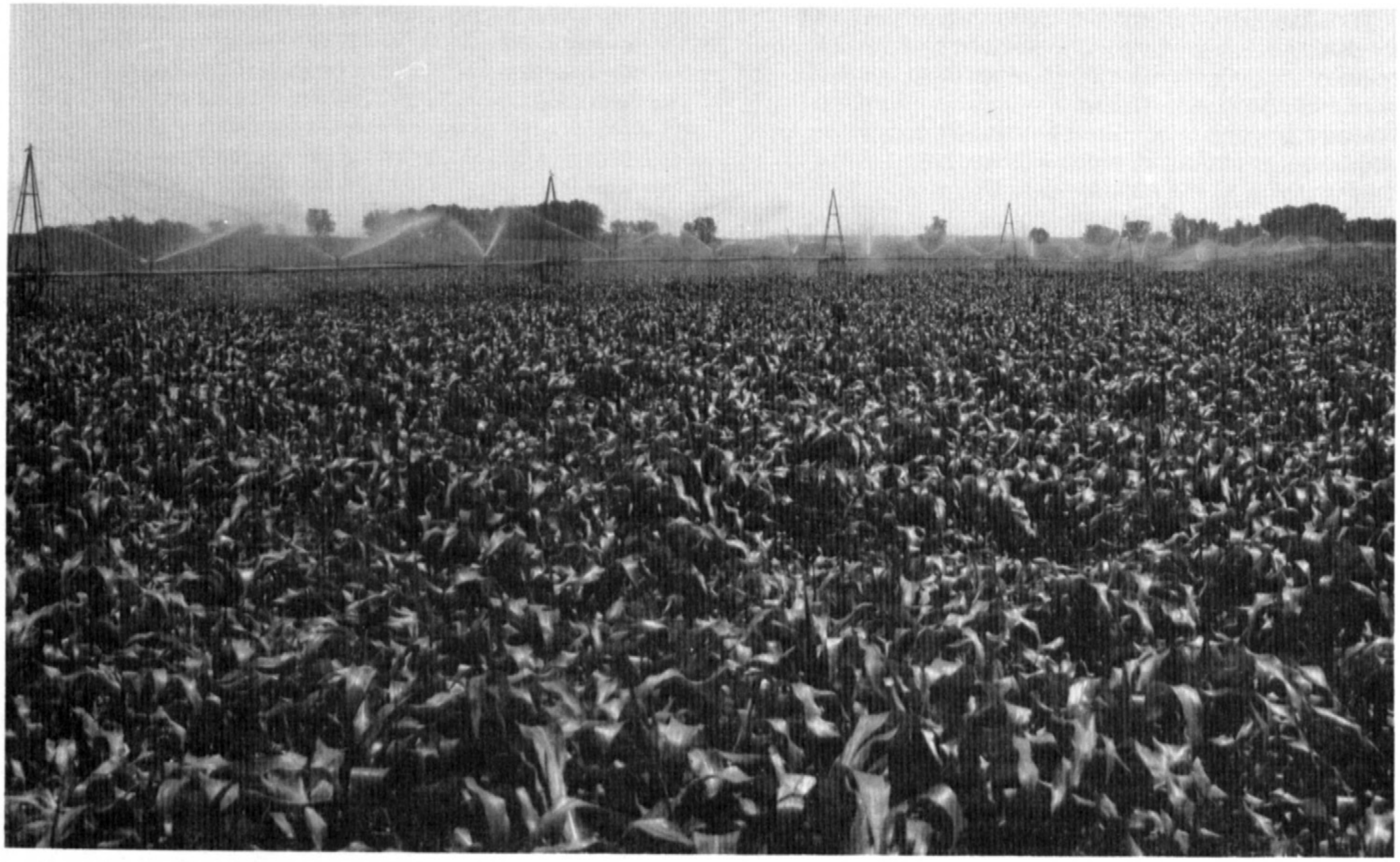

Figure 8.—Sprinkler irrigation in an area of Dunday loamy fine sand, 0 to 3 percent slopes, used for corn.

grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to a suitable grass mixture if a proper seedbed is prepared and a suitable cover crop is grown for 2 years.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to some of the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand somewhat droughty conditions. Irrigation is needed during dry periods. A scarcity of moisture and a severe hazard of soil blowing are the principal concerns in establishing trees. Soil blowing can be controlled by strips of sod or other vegetation between the tree rows. Weeds and undesirable grasses can be controlled by cultivating with conventional equipment or by applying herbicide.

This soil is suitable as a site for dwellings and local roads. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of nearby water supplies. Sealing sewage lagoons helps to prevent seepage. The sides of shallow excavations can cave in unless they are temporarily shored.

The land capability units are IVe-5, dryland, and IIIe-11, irrigated; Sandy range site; windbreak suitability group 5.

DuC—Dunday loamy fine sand, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. It formed in sandy eolian material. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 9 inches thick. The subsurface layer also is dark grayish brown, very friable loamy fine sand. It is about 5 inches thick. The transition layer is grayish brown, very friable loamy sand about 9 inches thick. The underlying material to a depth of more than 60 inches is fine sand. It is pale brown in the upper part and very pale brown in the lower part. In some places the upper part of the surface layer is sand, fine sand, or loamy sand. In other places the dark color of the surface layer extends to a depth of less than 10 inches. In cultivated areas on ridgetops and knolls, the soil is eroded and is lighter colored than the surrounding soils.

Included with this soil in mapping are small areas of Anselmo, Boelus, and Ipage soils. Anselmo soils are in landscape positions similar to those of the Dunday soil. They have more clay in the subsoil than the Dunday soil. Boelus soils are in the lower landscape positions. They have silty and loamy underlying material. Ipage soils are moderately well drained and are in upland swales. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Dunday soil, and the available water capacity is low. Organic matter content is moderately low. The water intake rate is very high. Runoff is slow.

A large acreage of this soil is farmed. The rest supports native grasses. Some of the farmed areas are irrigated.

If used for dryland farming, this soil is poorly suited to corn, soybeans, small grain, alfalfa, and introduced grasses. Small grain and the first cutting of alfalfa are generally the most dependable crops because they grow and mature in the spring, when the amount of rainfall is highest. Windblown sand sometimes destroys small plants early in spring. A cropping system that maintains a cover of crops or crop residue helps to control soil blowing, conserves moisture, and helps to maintain the organic matter content and the natural fertility level. A cropping sequence dominated by close-growing crops helps to protect the soil and conserves moisture. Stripcropping and field windbreaks help to control soil blowing. Returning crop residue to the soil and adding barnyard manure increase the organic matter content and improve fertility.

If irrigated, this soil is suited to corn, sorghum, alfalfa, small grain, and introduced grasses. A sprinkler system is the best method of irrigation because light, frequent applications of water are needed. One large application can result in excessive leaching of plant nutrients. Soil blowing can be controlled and organic matter content increased by applying a stubble mulch system of tillage, returning crop residue to the soil, and planting winter cover crops and close-growing crops (fig. 9).

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by prairie sandreed, sand bluestem, needleandthread, little bluestem, and blue grama. These species make up 70 percent or more of the total annual production. Sand dropseed, indiangrass, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, bluegrass, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with Sands or Choppy Sands range sites. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to a suitable grass mixture if a proper seedbed is prepared and a suitable cover crop is grown for 2 years.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing

Figure 9.—An area of Dunday loamy fine sand, 3 to 6 percent slopes, where corn stubble helps to control soil blowing.

height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to some of the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand droughty conditions. These species can survive and grow fairly well. A scarcity of moisture, competition from grasses and weeds, and soil blowing are the main problems. Irrigation is needed during periods of low rainfall. Weeds and grasses can be controlled by applying appropriate herbicides or by cultivating between the tree rows. Cultivation should be restricted to the tree rows. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the rows.

This soil is suitable as a site for dwellings and local roads. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of nearby water supplies. Lining or sealing sewage lagoons helps to prevent seepage. The sides of shallow excavations can cave in unless they are temporarily shored.

The land capability units are IVe-5, dryland, and IVe-11, irrigated; Sandy range site; windbreak suitability group 5.

Eb—Els loamy sand, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on the bottom of valleys and in low areas in the sandhills. It is subject to rare flooding. It formed in mixed eolian and alluvial sandy material. Areas range from 5 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 7 inches thick. The transition layer is grayish brown, very friable loamy sand about 9 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand. It has strong brown mottles. In places the surface layer is fine sand. In some areas strata of loam, silt loam, or silty clay loam are below a depth of 40 inches.

Included with this soil in mapping are small areas of Ipage and Tryon soils. Ipage soils are on the higher ridges and are moderately well drained. Tryon soils are in low areas and drainageways and are poorly drained and very poorly drained. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Els soil, and the available water capacity is low. Organic matter content is moderately low. The water intake rate is very high. Runoff is very slow. The depth to the seasonal high water table ranges from about 1.5 feet in wet years to 3.0 feet in dry years.

Most of the acreage of this soil supports native grasses and is used as hayland or range. A small acreage is cropland. Most of the cropland is irrigated.

If used for dryland farming, this soil is poorly suited to corn, soybeans, and alfalfa. It is generally unsuitable for small grain because the water table is highest in the spring. The wetness delays planting in spring and may prevent cultivation. During the dry parts of the year, the water table enhances the growth of grasses and cultivated crops. It may drown out alfalfa in some areas. Soil blowing is a hazard in cultivated areas. It can be controlled by applying a stubble mulch system of tillage, by returning crop residue to the soil, and by planting winter cover crops and close-grown crops. Applications of barnyard manure increase the organic matter content and improve fertility.

If irrigated, this soil is poorly suited to corn, soybeans, alfalfa, and introduced grasses. The wetness delays planting in spring and may prevent cultivation. A sprinkler system is the best method of irrigation. The water should be applied frequently and in small quantities. One large application can result in waterlogging and in excessive leaching of plant nutrients. Tile generally is not needed in irrigated areas, but the water table is a problem during wet periods. Soil blowing can be controlled by a stubble mulch system of tillage, a cover of crop residue, close-growing crops, and field windbreaks.

If this soil is used for range, the climax vegetation is dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges and rushes. These species make up 80 percent or more of the total annual production. Plains bluegrass, slender wheatgrass, western wheatgrass, and some forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, foxtail barley, slender wheatgrass, green muhly, and various sedges and rushes. Timothy, redtop, and clover also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, clover, and forbs, such as Baldwin ironweed, dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 1.7 animal unit months per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with better drained, sandy soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the maximum storage of these food reserves is completed by the frost period. The quality of the hay is higher when the grasses are cut earlier. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed from the meadows before the frost leaves the soil in the spring.

This soil is suitable for some of the trees and shrubs grown as windbreaks. The species selected for planting should be those that can withstand occasional wetness. Establishing the trees and cultivating between the tree rows can be difficult during wet periods. The site should be tilled and the trees planted after the soil dries out. The abundant and persistent herbaceous vegetation that grows in the tree rows competes with the trees. It can be controlled by cultivation or by applications of appropriate herbicide.

The wetness and a poor filtering capacity are limitations if this soil is used as a site for septic tank

absorption fields. The poor filtering capacity can result in the contamination of underground water. Fill material can elevate the absorption field a sufficient distance above the seasonal high water table. Lining or sealing sewage lagoons helps to prevent seepage. Fill material can raise the bottom of the lagoon a sufficient distance above the water table. The lagoon should be diked because of the flooding.

The sides of shallow excavations in this soil can cave in unless they are temporarily shored. The excavations should be made during dry periods. Building dwellings on raised, well compacted fill material helps to overcome the wetness caused by the high water table and helps to protect the site against flooding. Constructing local roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the road damage caused by flooding and wetness. The damage caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IVw-5, dryland, and IVw-11, irrigated; Subirrigated range site; windbreak suitability group 2S.

EfB—Els-Ipage fine sands, 0 to 3 percent slopes. These deep soils are on the bottom of upland valleys in or adjacent to the sandhills. The nearly level, somewhat poorly drained Els soil is in swales, and the very gently sloping, moderately well drained Ipage soil is on low ridges. The Els soil is subject to rare flooding. Both soils formed in sandy eolian and alluvial material. Areas range from 10 to several hundred acres in size. They are 25 to 65 percent Els soil and 20 to 60 percent Ipage soil. The two soils occur as areas so intricately mixed that separating them in mapping is not practical.

Typically, the Els soil has a surface layer of grayish brown, very friable fine sand about 6 inches thick. The transition layer is light brownish gray, loose fine sand about 4 inches thick. The underlying material to a depth of more than 60 inches is very pale brown sand. It has yellowish brown mottles at a depth of about 22 inches. In some areas the surface layer is loamy fine sand or loamy sand. In a few places loamy material or gravelly coarse sand is below a depth of 40 inches.

Typically, the Ipage soil has a surface layer of grayish brown, very friable fine sand about 5 inches thick. The transition layer is light brownish gray, loose fine sand about 6 inches thick. The underlying material to a depth of more than 60 inches is light gray fine sand. Yellowish brown mottles are below a depth of 32 inches. In places the surface layer is loamy sand.

Included with these soils in mapping are small areas of Tryon and Valentine soils. Tryon soils are on the lower parts of the landscape and are poorly drained or very poorly drained. Valentine soils are on the higher parts and are excessively drained. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Els and Ipage soils, and the available water capacity is low. Organic matter content is moderately low in the Els soil and low in the Ipage soil. The water intake rate is very high in both soils. Runoff is slow or very slow. The depth to the seasonal high water table in the Els soil ranges from about 1.5 feet in wet years to 3.0 in dry years. The depth to the seasonal high water table in the Ipage soil ranges from about 3 feet in wet years to 6 feet in dry years.

Most of the acreage supports native grasses and is used as range or hayland. The rest is mainly irrigated cropland. These soils are unsuited to dryland crops because they are droughty and because soil blowing is a hazard if the grass cover is removed from the Ipage soil.

If irrigated, these soils are suited to corn, soybeans, alfalfa, and introduced grasses. They are unsuitable for gravity methods of irrigation but can be sprinkler irrigated. Soil blowing is a severe hazard unless the surface is adequately protected. A drainage system is needed in some of the low areas. Soil blowing can be controlled by growing winter cover crops, planting close-growing crops, and leaving crop residue on the surface throughout the winter. Field windbreaks also help to control soil blowing. Applying barnyard manure increases the organic matter content and improves fertility.

These soils are suited to range and native hay. The climax vegetation on the Els soil is dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges and rushes. These species make up 80 percent or more of the total annual production on this soil. Plains bluegrass, slender wheatgrass, western wheatgrass, and forbs make up the rest. Big bluestem, indiangrass, switchgrass, little bluestem, and prairie cordgrass decrease in abundance under continuous heavy grazing or improper haying. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, slender wheatgrass, green muhly, and various sedges and rushes. If overuse continues for many years, the site is dominated by bluegrass, sedges, rushes, clover, and other forbs.

The dominant species on the Ipage soil are sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. These species make up 60 percent or more of the total annual production on this soil. Blue grama, indiangrass, Kentucky bluegrass, prairie junegrass, Scribner panicum, leadplant, and sedges make up the rest. If the range is overgrazed, these plants are initially replaced by prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.7 animal unit months per acre on the Els soil and 1.0 animal unit month per acre on the Ipage soil. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture.

If these soils are used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. Mowing should be regulated so that the grasses remain vigorous and healthy. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. During periods when the ground is frozen, livestock can graze without damaging the meadows if a proper stocking rate is used.

These soils are suited to the trees and shrubs grown as windbreaks if soil blowing is controlled. The species selected for planting on the Els soil should be those that can withstand occasional wetness. Establishing seedlings can be difficult during wet years. The site should be tilled and the trees planted after the soil dries out. Because the Ipage soil is loose, the trees should be planted in shallow furrows and the site should not be cultivated. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the tree rows. Young seedlings can be damaged by windblown sand during periods of high winds. The abundant and persistent herbaceous vegetation that grows in the tree rows can be controlled by cultivation or by appropriate herbicides.

These soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the contamination of underground water. Fill material can elevate the absorption field a sufficient distance above the seasonal high water table. Lining on sealing sewage lagoons helps to prevent seepage. Fill material can raise the bottom of the lagoon a sufficient distance above the water table. Lagoons constructed on the Els soil should be diked because of the flooding.

The sides of shallow excavations in these soils can cave in unless they are temporarily shored. Excavations in the Els soil should be made during dry periods. The Ipage soil is generally suitable as a site for dwellings without basements. All dwellings on the Els soil and dwellings with basements on the Ipage soil should be constructed on well compacted fill material, which helps to overcome the wetness caused by the high water table and helps to protect the site against flooding.

Local roads constructed on these soils can be damaged by frost action. This damage can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage. Constructing the roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by wetness and flooding on the Els soil.

The land capability units are VIe-5, dryland, and IVe-12, irrigated. The Els soil is in the Subirrigated range site and in windbreak suitability group 2S. The Ipage soil is in the Sandy Lowland range site and in windbreak suitability group 7.

Em—Elsmere loamy fine sand, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom land along streams and in sandhill valleys. It is subject to rare flooding. It formed in mixed eolian and alluvial sandy material. Areas range from 5 to 400 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 12 inches thick. The subsurface layer is grayish brown, very friable loamy fine sand about 4 inches thick. The transition layer is light brownish gray, very friable loamy sand about 8 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand. It has yellowish brown mottles. In a few places the surface layer is 6 to 10 inches thick. In some areas thin layers of loamy and clayey material are at a depth of 20 to 40 inches. In a few areas coarse sand or gravelly coarse sand is below a depth of 20 inches.

Included with this soil in mapping are small areas of Ipage and Loup soils. Ipage soils are in the higher landscape positions and are moderately well drained. Loup soils are in the lower positions and are poorly drained or very poorly drained. Also included are spots that are strongly affected by alkali. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Elsmere soil, and the available water capacity is low. Organic matter content is moderate. The water intake rate is very high. Runoff is very slow. The depth to the seasonal high water table from 1.5 feet in wet years to about 3.0 feet in dry years.

Most of the acreage of this soil supports native grasses and is used as range or hayland. The rest is cropland.

If used for dryland farming, this soil is poorly suited to corn, soybeans, and small grain. It is susceptible to soil blowing if it is cultivated. It is commonly too wet for cultivation during the wettest periods. During dry parts of the year, the water table subirrigates the soil. Working the soil early in the spring is difficult because the water table keeps the surface wet. If the soil is used for alfalfa or other close-growing crops, the need for working the soil in the spring is eliminated. Also, these crops help to control soil blowing during dry periods. The high water table may drown out the alfalfa in some areas. Keeping crop residue on the surface helps to control soil blowing.

If irrigated, this soil is poorly suited to corn, soybeans, alfalfa, and introduced grasses. A sprinkler system is the best method of irrigation. The water should be applied frequently and in small amounts. One large application can result in waterlogging and excessive leaching of plant nutrients. Tile generally is not needed, but the water table may be a problem during wet periods. Soil blowing can be controlled by applying a stubble mulch system of tillage, keeping crop residue on the surface throughout the winter, and planting winter cover crops and close-growing crops. Applying barnyard manure increases the organic matter content and improves fertility.

If this soil is used for range, the climax vegetation is dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges and rushes. These species make up 80 percent or more of the total annual production. Plains bluegrass, slender wheatgrass, western wheatgrass, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, little bluestem, switchgrass, indiangrass, and prairie cordgrass decrease in abundance. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, foxtail barley, slender wheatgrass, green muhly, and various sedges and rushes. Timothy, redtop, and clover also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, clover, and other forbs, such as Baldwin ironweed, dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 1.7 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This generally is the first soil to be overgrazed when it is grazed in conjunction with better drained soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture.

If this soil is used as hayland, mowing should be regulated so that grasses remain vigorous. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the maximum storage of these food reserves is completed by the frost period. The quality of the hay is higher when the grasses are cut earlier. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed before the frost leaves the soil in the spring.

This soil is suited to some of the trees and shrubs grown as windbreaks. The species selected for planting should be those that can withstand occasional wetness. In some years establishing seedlings and cultivating between the tree rows are difficult because of the wetness. Planting should be delayed until the soil begins to dry. The abundant and persistent herbaceous vegetation on this soil competes with the trees and shrubs for moisture. It can be controlled by cultivating with conventional equipment or by applying appropriate herbicides.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Fill material can elevate the absorption field a sufficient distance above the seasonal high water table. Lining or sealing sewage lagoons helps to prevent seepage. Fill material can raise the bottom of the lagoon a sufficient distance above the water table. The lagoon should be diked because of the flooding.

The sides of shallow excavations in this soil can cave in unless they are temporarily shored. Excavations should be made during dry periods. Dwellings should be constructed on raised, well compacted fill material, which helps to overcome the wetness caused by the high water table and helps to protect the site against flooding. Constructing local roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the road damage caused by flooding and wetness. The damage caused by frost action can be minimized by a good surface drainage

system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IVw-5, dryland, and IVw-11, irrigated; Subirrigated range site; windbreak suitability group 2S.

EnB—Elsmere-Ipage loamy fine sands, 0 to 3 percent slopes. These deep soils are on bottom land and in sandhill valleys. The nearly level, somewhat poorly drained Elsmere soil is in swales. It is subject to rare flooding. The very gently sloping, moderately well drained Ipage soil is in the slightly higher areas. Both soils formed in sandy eolian and alluvial material. Areas range from 10 to 200 acres in size. They are 25 to 65 percent Elsmere soil and 20 to 60 percent Ipage soil. The two soils occur as areas so intricately mixed that separating them in mapping is not practical.

Typically, the Elsmere soil has a surface layer of dark grayish brown, friable loamy fine sand about 12 inches thick. The transition layer is grayish brown, loose fine sand about 12 inches thick. The underlying material to a depth of more than 60 inches is light gray fine sand. It has yellowish brown mottles. In some places the surface layer is fine sandy loam. In other places it is 6 to 10 inches thick. In a few areas coarse sand or gravelly coarse sand is at a depth of 20 to 40 inches. In some areas loamy material is below a depth of 40 inches.

Typically, the Ipage soil has a surface layer of dark grayish brown, very friable loamy fine sand about 6 inches thick. The transition layer is grayish brown, loose fine sand about 7 inches thick. The underlying material to a depth of more than 60 inches is fine sand. It is pale brown in the upper part and very pale brown in the lower part. It has yellowish brown mottles below a depth of 30 inches. In some places the surface layer is loamy sand or fine sand. In other places it is 10 to 18 inches thick. In a few areas dark buried layers are below a depth of 40 inches. In a few places coarse sand or gravelly coarse sand is at a depth of 20 to 40 inches.

Included with these soils in mapping are small areas of Dunday, Loup, and Valentine soils. The poorly drained or very poorly drained Loup soils are on the lower parts of the landscape. The well drained Dunday and excessively drained Valentine soils are on the higher parts. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Elsmere and Ipage soils, and the available water capacity is low. Organic matter content is moderate in the Elsmere soil and low in the Ipage soil. The water intake rate is very high in both soils. Runoff is slow or very slow. The depth to the seasonal high water table in the Elsmere soil ranges from about 1.5 feet in wet years to 3.0 feet in dry years. The depth to the seasonal high water table in the Ipage soil ranges from about 3 feet in wet years to 6 feet in dry years.

Most of the acreage of these soils supports native grasses and is used as range or hayland. A few areas are used as cropland.

If used for dryland farming, these soils are poorly suited to corn, soybeans, and small grain. They are suited to alfalfa in areas where the water table is not too high. Unless the surface is protected, the soils are highly susceptible to soil blowing. Also, a drainage system is needed in some areas. A cropping system that maintains a cover of crops, grasses, or crop residue helps to control soil blowing, conserves moisture, and maintains the organic matter content and fertility. Field windbreaks also help to control soil blowing.

If irrigated, these soils are suited to corn, soybeans, alfalfa, and introduced grasses. A sprinkler system is the best method of applying irrigation water. Applications should be light and frequent. One large application can result in excessive leaching of plant nutrients. Soil blowing is a hazard. It can be controlled by planting winter cover crops and close-growing crops and by leaving crop residue on the surface. The high water table in the Elsmere soil is a problem. A surface drainage system may be needed. Tile generally is not needed in irrigated areas.

In the areas used as range, the climax vegetation on the Elsmere soil is dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges and rushes. These species make up 80 percent or more of the total annual production on this soil. Plains bluegrass, slender wheatgrass, western wheatgrass, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, little bluestem, switchgrass, indiangrass, and prairie cordgrass decrease in abundance. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, foxtail barley, slender wheatgrass, green muhly, and various sedges and rushes. Timothy, redtop, and clover also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, clover, and other forbs, such as Baldwin ironweed, dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

The climax vegetation on the Ipage soil is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. These species make up 75 percent or more of the total annual production on this soil. Blue grama, sand dropseed, indiangrass, sand lovegrass, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, indiangrass, sand lovegrass, little bluestem, and switchgrass decrease in abundance. Initially, these plants are replaced by prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, annual grasses, and

forbs. If overgrazing continues for many years, blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.7 animal unit months per acre on the Elsmere soil and 1.0 animal unit month per acre on the Ipage soil. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying and restricted use during wet periods helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities. The areas away from the watering facilities may be underused. These generally are the first soils to be overgrazed when they are grazed in conjunction with better drained soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture.

If these soils are used as hayland, mowing should be regulated so that the grasses remain vigorous. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the maximum storage of these food reserves is completed by the frost period. The quality of the hay is higher when the grasses are cut earlier. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed before the frost leaves the soil in the spring.

These soils are suited to the trees and shrubs grown as windbreaks if soil blowing is controlled. The species selected for planting on the Elsmere soil should be those that can withstand occasional wetness. Establishing trees can be difficult during wet periods. The site should be tilled and the trees planted after the soil begins to dry. Soil blowing, drought, and competition for moisture from grasses and weeds are the main problems on the Ipage soil. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Irrigation may be needed during periods of low rainfall. Weeds and grasses can be controlled by cultivation and by appropriate herbicides.

These soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the contamination of ground water. Fill material can elevate the absorption field a sufficient distance above the seasonal high water table. Lining or sealing sewage lagoons helps to prevent seepage. Fill material can raise the bottom of the lagoon a sufficient distance above the water table. Lagoons constructed on the Elsmere soil should be diked because of the flooding.

The sides of shallow excavations in these soils can cave in unless they are temporarily shored. Excavations in the Elsmere soil should be made during dry periods. The Ipage soil is generally suitable as a site for dwellings without basements. All dwellings on the Elsmere soil and dwellings with basements on the Ipage soil should be constructed on well compacted fill material, which helps to overcome the wetness caused by the seasonal high water table and helps to protect the site against flooding.

Local roads constructed on these soils can be damaged by frost action. This damage can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage. Constructing the roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the damage caused by wetness and flooding on the Elsmere soil.

The land capability units are IVe-5, dryland, and IVe-11, irrigated. The Elsmere soil is in the Subirrigated range site and in windbreak suitability group 2S. The Ipage soil is in the Sandy Lowland range site and in windbreak suitability group 5.

Ep—Elsmere-Loup complex, 0 to 2 percent slopes. These deep, nearly level soils are on bottom land. They are subject to rare flooding. The somewhat poorly drained Elsmere soil is in the higher areas. It formed in mixed eolian and alluvial sandy material. The poorly drained Loup soil is on the lowest parts of the landscape. It formed in sandy alluvium. Areas range from 10 to 1,500 acres in size. They are 35 to 60 percent Elsmere soil and 20 to 45 percent Loup soil. The two soils occur as areas so intricately mixed that separating them in mapping is not practical.

Typically, the Elsmere soil has a surface layer of very dark grayish brown, very friable, calcareous loamy fine sand about 8 inches thick. The subsurface layer is dark grayish brown, very friable loamy fine sand about 10 inches thick. The transition layer is grayish brown, very friable loamy sand about 6 inches thick. The underlying material to a depth of more than 60 inches is light gray fine sand. It has yellowish brown mottles. In some places the surface layer is fine sandy loam. In other places it is 6 to 10 inches thick. In some areas thin strata of loamy material are below a depth of 40 inches.

Typically, the Loup soil has a surface layer of very dark gray, very friable, calcareous fine sandy loam about 6 inches thick. The subsurface layer is dark gray, friable fine sandy loam about 6 inches thick. The transition layer

is dark grayish brown, very friable sandy loam about 4 inches thick. It has dark brown mottles. The underlying material to a depth of more than 60 inches is fine sand. It is gray in the upper part and light gray in the lower part. In some areas the surface layer is sandy loam to silt loam. In a few places the underlying material has sandy and loamy strata.

Included with these soils in mapping are small areas of Ipage and Marlake soils. Ipage soils are in the higher landscape positions and are moderately well drained. Marlake soils are in the lower positions and are very poorly drained. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Elsmere and Loup soils, and the available water capacity is low. Organic matter content is moderate in the Elsmere soil and high in the Loup soil. Runoff is very slow on both soils. The seasonal high water table in the Elsmere soil is at a depth of about 1.5 feet in wet years and 3.0 feet in dry years. It may drop to a depth of about 5 to 6 feet during extended dry periods. The seasonal high water table in the Loup soil is at or near the surface in wet years and is within a depth of about 1.5 feet in dry years. It normally drops to a depth of 2 to 3 feet by late summer.

Most of the acreage of these soils supports native grasses and is used as range or hayland. The Loup soil generally is too wet for cultivation.

In the areas used as range, the climax vegetation on the Elsmere soil is dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges and rushes. These species make up 80 percent or more of the total annual production on this soil. Plains bluegrass, slender wheatgrass, western wheatgrass, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, foxtail barley, slender wheatgrass, green muhly, and various sedges and rushes.

The climax vegetation on the Loup soil is dominated by big bluestem, bluejoint reedgrass, indiangrass, northern reedgrass, prairie cordgrass, switchgrass, and various sedges and rushes. These species make up 75 percent or more of the total annual production on this soil. Bluegrass, slender wheatgrass, Canada wildrye, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, bluejoint reedgrass, northern reedgrass, prairie cordgrass, switchgrass, indiangrass, and reed canarygrass decrease in abundance. Initially, these species are replaced by slender wheatgrass, western wheatgrass, plains muhly, and various sedges. Timothy, redtop, and clover also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, clover, and other forbs, such as Baldwin ironweed, dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 1.7 animal unit months per acre on the Elsmere soil and 1.9 animal unit months per acre on the Loup soil. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities. The areas away from the watering facilities may be underused. These are generally the first soils to be overgrazed when they are grazed in conjunction with better drained, sandy soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture.

If these soils are used as hayland, mowing should be regulated so that the grasses remain vigorous. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the maximum storage of these food reserves is completed by the frost period. The quality of the hay is higher when the grasses are cut earlier. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed before the frost leaves the soil in the spring.

The Elsmere soil is suited to some of the trees and shrubs grown as windbreaks. The species selected for planting should be those that can withstand occasional wetness. In some years establishing seedlings and cultivating between the tree rows are difficult because of the wetness. The site should be tilled and the seedlings planted after the soil has begun to dry. The abundant and persistent herbaceous vegetation on this soil competes with the trees and shrubs for moisture. It can be controlled by cultivation. Because of the wetness, the Loup soil is poorly suited to the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand a very high water table. Establishing trees can be difficult in wet years. Special methods of planting may be needed to keep the seedlings from drowning.

Onsite investigation may be needed to identify suitable sites for planting.

The Elsmere soil is suitable as a site for septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. Fill material can elevate the absorption field a sufficient distance above the seasonal high water table. The Loup soil is not suitable as a site for septic tank absorption fields because of the wetness. A suitable alternative site is needed. Fill material can raise the bottom of sewage lagoons a sufficient distance above the water table in these soils. Lining or sealing the lagoon helps to prevent seepage.

The sides of shallow excavations in these soils can cave in unless they are temporarily shored. Excavations in the Loup soil should be made during dry periods. Dwellings should be constructed on raised, well compacted fill material, which helps to overcome the wetness caused by the seasonal high water table and helps to protect the site against flooding. Constructing local roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the road damage caused by wetness, flooding, and frost action.

The land capability unit is Vw-7, dryland. The Elsmere soil is in the Subirrigated range site and in windbreak suitability group 2S. The Loup soil is in the Wet Subirrigated range site and in windbreak suitability group 2D.

Eu—Elsmere-Selia loamy fine sands, 0 to 2 percent slopes. These deep, nearly level, somewhat poorly drained soils are on bottom land. They are subject to rare flooding. They formed in sandy alluvial and eolian material. Areas range from 10 to 50 acres in size. They are 45 to 60 percent Elsmere soil and 25 to 40 percent Selia soil. Areas of the Selia soil are irregular in shape and are about 5 to 100 feet across. They are surrounded by larger areas of the Elsmere soil. The two soils occur as areas so intricately mixed that separating them in mapping is not practical.

Typically, the Elsmere soil has a surface layer of dark grayish brown, very friable loamy fine sand about 14 inches thick. The transition layer is grayish brown, very friable loamy sand about 8 inches thick. The underlying material to a depth of more than 60 inches is light brownish gray and very pale brown fine sand. It has reddish brown mottles. Dark buried layers are common. In some areas the surface layer is less than 10 inches thick. In a few areas loamy material, coarse sand, or gravelly coarse sand is at a depth of 20 to 60 inches.

Typically, the Selia soil has a surface layer of gray, very friable loamy fine sand about 4 inches thick. The subsurface layer is light gray, loose fine sand about 1 inch thick. The subsoil is about 23 inches thick. The upper part is dark gray, friable loamy fine sand, and the lower part is grayish brown, friable loamy sand. The underlying material to a depth of more than 60 inches is fine sand. It is light gray in the upper part and very pale brown in the lower part. It has reddish brown mottles. In some areas the surface layer is fine sandy loam. In other areas loamy material is at a depth of 40 to 60 inches.

Included with these soils in mapping are small areas of Loup and Ord soils. Loup soils are in the slightly lower landscape positions and are poorly drained or very poorly drained. Ord soils have a transition layer that is finer textured than that of the Elsmere soil. They are in positions on the landscape similar to those of the Elsmere and Selia soils. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Elsmere soil. It is slow in the subsoil of the Selia soil and moderately rapid in the underlying material. The available water capacity is low in both soils. Organic matter content is moderate. The water intake rate is very high in the Elsmere soil and moderately low in the Selia soil. Runoff generally is slow or very slow on both soils, but some microdepressions in areas of the Selia soil are ponded. The Elsmere soil is medium acid to moderately alkaline. The Selia soil is neutral to very strongly alkaline. It has a high content of sodium. The depth to the seasonal high water table in the Elsmere soil ranges from about 1.5 feet in wet years to 3.0 feet in dry years. The depth to the seasonal high water table in the Selia soil ranges from about 1.5 feet in wet years to 2.5 feet in dry years. The Elsmere soil can be easily tilled, but the Selia soil is difficult to till because it has poor soil structure and becomes very hard when dry.

Nearly all of the acreage supports native grasses and is used for grazing or hay. A small acreage is used as cropland. This map unit is unsuited to dryland crops because of the high alkalinity of the Selia soil and the resulting droughtiness. The Elsmere soil is suited to dryland crops, but it occurs as areas so intermixed with areas of the Selia soil that it cannot be farmed separately.

If irrigated, these soils are poorly suited to corn, alfalfa, and alkali-tolerant grasses. Crops do not grow well on the Selia soil. The principal management concerns are alkalinity, the level of fertility, and the hazard of soil blowing. A sprinkler system is the best method of irrigation. The soils are too sandy for gravity irrigation. The water should be applied frequently and in small amounts. One large application can result in waterlogging and in excessive leaching of plant nutrients. Some grading may be needed to fill in small depressions and to improve surface drainage. Tile generally is not needed in irrigated areas, but the water table is a problem during periods when rainfall is above normal. During dry periods the water table subirrigates the soils. Unless the surface is protected, soil blowing is a hazard during these periods. It can be controlled by planting close-growing crops, applying a system of stubble mulch

tillage, and growing winter cover crops. Because of the alkalinity, many of the nutrients in the Selia soil are not available to plants. As a result, measures that improve fertility are needed. Adding large quantities of barnyard manure and other organic matter, growing legumes, and returning crop residue to the soil improve fertility, help to make the Selia soil more friable, and increase the rate of water intake.

Reclamation of Selia and other alkali soils is difficult and expensive. Alkali conditions can be improved by chemical amendments. They also can be improved by leaching the soil and then applying measures that build soil structure. Chemical amendments, such as gypsum and sulfur, are expensive. The kind and amount needed should be based on the results of chemical soil tests. Leaching is not successful if the water table is too close to the surface. The water table should be at least 4.5 to 5.0 feet below the surface during most of the growing season. If suitable outlets are available, tile drains or open ditches can lower the water table. The amount of water that enters the soil determines how much salt is removed from the soil. The common method of leaching is to spread water over the alkali area. Applying the water through irrigation sprinklers is generally more costly than other methods. Also, the sprinklers tend to apply too little water. As a result, leaching of salts from the entire root zone does not occur. Applications of manure or other kinds of organic material improve soil structure after the amendments have been added and the soil is leached.

These soils are suited to native grasses used for grazing or hay. The alkalinity of the Selia soil, however, cannot be easily controlled. Most ranchers conform the grazing system and mowing patterns to the alkali soil conditions. The climax vegetation on the Elsmere soil is dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges and rushes. These species make up 80 percent or more of the total annual production on this soil. Plains bluegrass, slender wheatgrass, western wheatgrass, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, foxtail barley, slender wheatgrass, green muhly, and various sedges and rushes. Timothy, redtop, and clover also increase in abundance if they have been overseeded.

The climax vegetation on the Selia soil is dominated by alkali sacaton, inland saltgrass, plains bluegrass, western wheatgrass, slender wheatgrass, switchgrass, and various sedges. These species make up 70 percent or more of the total annual production on this soil. Alkali cordgrass, little bluestem, foxtail barley, blue grama, alkali muhly, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing or improper haying, alkali sacaton, western wheatgrass, slender wheatgrass, switchgrass, little bluestem, and alkali cordgrass decrease in abundance. Initially, these species are replaced by inland saltgrass, alkali muhly, blue grama, Kentucky bluegrass, foxtail barley, sand dropseed, and sedges. If further deterioration occurs, inland saltgrass, blue grama, Kentucky bluegrass, foxtail barley, buffalograss, sedges, rushes, dandelions, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.7 animal unit months per acre on the Elsmere soil and 1.0 animal unit month per acre on the Selia soil. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities. The areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is effective in controlling soil blowing. The alkali conditions limit forage production and the kinds of grasses that can be grown. Short grasses are more extensive in the highly alkali areas. Careful management is needed to maintain the plant cover.

Short and tall grasses grow in irregular patterns on these soils. As a result, haying is difficult. Mowing should be regulated so that the grasses remain vigorous. It should be avoided during the period between the boot stage and seed maturity. Mowing before the grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the maximum storage of these food reserves is completed by the frost period. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed before the frost leaves the soil in the spring.

The Elsmere soil is suited to the trees and shrubs grown as windbreaks, but the Selia soil is unsuited. The species that can withstand occasional wetness survive and grow well on the Elsmere soil. Trees and shrubs survive and grow poorly on the Selia soil. The species that can withstand occasional wetness and alkali conditions should be selected for planting on this soil. During wet years planting should be delayed until the soil is sufficiently dry. The abundant and persistent herbaceous vegetation on these soils competes with the trees and shrubs. The weeds and grasses between the tree rows can be controlled by cultivating with

conventional equipment or by applying appropriate herbicides. The areas in the rows and close to the trees can be hoed by hand.

These soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Fill material can elevate the absorption field a sufficient distance above the seasonal high water table. It also can raise the bottom of sewage lagoons a sufficient distance above the water table. Lining or sealing the lagoon helps to prevent seepage.

The sides of shallow excavations in these soils can cave in unless they are temporarily shored. The excavations should be made during dry periods. Dwellings should be constructed on well compacted fill material, which helps to overcome the wetness caused by the seasonal high water table and helps to protect the site against flooding. Constructing local roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the road damage caused by flooding and wetness. The damage caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are VIs-1, dryland, and IVs-11, irrigated. The Elsmere soil is in the Subirrigated range site and in windbreak suitability group 2S. The Selia soil is in the Saline Subirrigated range site and in windbreak suitability group 10.

Fu—Fluvaquents, sandy. These deep, nearly level, very poorly drained soils are in oxbows and low areas bordering the larger streams. They are frequently ponded by water from stream overflow and a very high water table. They formed in sandy alluvium. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark gray, very friable loamy fine sand about 7 inches thick. The transition layer is about 15 inches of grayish brown, friable loamy sand stratified with black, loamy material. It has yellowish brown mottles. The underlying material to a depth of more than 60 inches is light brownish gray fine sand stratified with loamy sand.

Included with these soils in mapping are small areas of Loup and Tryon soils. These included soils are in the slightly higher landscape positions and are not so wet as the Fluvaquents. Also included are small areas of ponded water on the low parts of the landscape and in former stream channels and oxbows. Included areas make up 5 to 15 percent of the unit.

Permeability is rapid in the Fluvaquents, and the available water capacity is low. Organic matter content is high. Runoff generally is ponded. The seasonal high water table is as much as 2 feet above the surface in wet years and is within a depth of about 1 foot in dry years. Water covers the surface for long periods during most years. During extended dry periods, however, the water table usually drops below the surface.

Most areas are used for wildlife habitat or for grazing by livestock. These soils are too wet for cultivated crops, hay, and range. The vegetation is mainly cattails, rushes, arrowheads, willows, and other water-tolerant plants. It is not palatable to livestock. In some areas V-ditches can be installed to improve surface drainage. Such grasses as prairie cordgrass and reed canarygrass can then be established. The vegetation can be mowed only during extremely dry years.

These soils are unsuited the trees and shrubs grown as windbreaks because of the wetness. A few marginal areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat and for forestation plantings if suitable species are hand planted or other special management is applied.

These soils are generally unsuitable as sites for septic tank absorption fields, sewage lagoons, and dwellings because of the ponding. A suitable alternative site is needed. The sides of shallow excavations can cave in unless they are temporarily shored. The excavations can be made only during extremely dry periods. Constructing local roads on suitable, well compacted fill material above the ponding level and providing adequate side ditches and culverts help to prevent the road damage caused by ponding.

The land capability unit is VIIIw-7, dryland; windbreak suitability group 10. No range site is assigned.

GfB—Gates very fine sandy loam, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, well drained soil is on uplands. It formed in reworked or recently deposited loess. Areas range from 5 to 60 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 6 inches thick. The transition layer is brown, friable very fine sandy loam about 12 inches thick. The underlying material to a depth of more than 60 inches is very pale brown very fine sandy loam. Lime is at a depth of about 18 inches. In some areas the surface layer is fine sandy loam. In a few areas it is more than 6 inches thick. In places the entire profile is noncalcareous.

Included with this soil in mapping are small areas of Hersh and Valentine soils. Hersh soils are in positions on the landscape similar to those of the Gates soil. They contain more sand than the Gates soil. Valentine soils occur as small dunes and are sandy throughout. Also included, in swales in the sandhills, are some areas where 6 to 18 inches of sandy material has been deposited on the surface. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Gates soil, and the available water capacity is high. Organic matter content

is low. The water intake rate is moderate. Runoff is slow. The soil can be easily worked.

Most of the acreage of this soil is used as range. The rest is used as hayland. Some small areas in swales in the sandhills formerly were farmed but now support grasses.

If used for dryland farming, this soil is suited to corn, sorghum, small grain, and alfalfa. Measures that conserve moisture, improve fertility, and increase the organic matter content are the main management needs. An example is a cropping system that keeps crop residue on the surface. Growing green manure crops, returning crop residue to the soil, and adding barnyard manure improve fertility and tilth.

If irrigated, this soil is suited to corn, sorghum, alfalfa, small grain, and introduced grasses. It is suited to gravity and sprinkler methods of irrigation. Some land shaping is needed if a gravity system is used. Maintaining fertility and properly distributing irrigation water are the main management problems. Keeping crop residue on the surface conserves moisture and helps to control soil blowing.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated big bluestem, little bluestem, sideoats grama, switchgrass, and indiangrass. These species make up 70 percent or more of the total annual production. Blue grama, buffalograss, needleandthread, prairie junegrass, Scribner panicum, western wheatgrass, leadplant, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, indiangrass, prairie junegrass, and switchgrass decrease in abundance. Initially, these species are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose plant vigor and are unable to stabilize the site. Under these conditions, excessive water erosion and soil blowing occur.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. Drought and competition for moisture from weeds and grasses are the main problems. Irrigation is needed during dry periods. Cultivating between the tree rows with conventional equipment and applying appropriate herbicides help to control the undesirable weeds and grasses. The areas in the row or near small trees can be rototilled or hoed by hand.

This soil is suitable as a site for septic tank absorption fields and dwellings. Seepage is a hazard on sites for sewage lagoons. It can be controlled by lining or sealing the lagoon. The sides of shallow excavations can cave in unless they are temporarily shored. The damage to local roads and streets caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIe-9, dryland, and IIe-6, irrigated; Silty range site; windbreak suitability group 3.

GfC—Gates very fine sandy loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on side slopes in the uplands. A few areas are hummocky. The soil formed in reworked or recently deposited loess. Areas range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 6 inches thick. The transition layer is pale brown, very friable very fine sandy loam about 13 inches thick. The underlying material to a depth of more than 60 inches is very pale brown very fine sandy loam. Lime is at a depth of about 19 inches. In places the surface layer is fine sandy loam. In some eroded areas carbonates are near the surface. In some areas the entire profile is noncalcareous.

Included with this soil in mapping are small areas of Hobbs, Hersh, and Valentine soils. Hobbs soils are

stratified throughout. They are on bottom land. Hersh and Valentine soils contain more sand than the Gates soil. Hersh soils are in positions on the landscape similar to those of the Gates soil. Valentine soils are in the slightly higher positions. Also included are a few areas where a thin layer of sandy material is at the surface. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Gates soil, and the available water capacity is high. Organic matter content is low. The water intake rate is moderate. Runoff is medium. Because of the low organic matter content, the soil tends to puddle if worked when too wet.

Most areas of this soil are farmed. The rest support native grasses and are used as range or hayland. Some areas that formerly were farmed have been seeded to grasses.

If used for dryland farming, this soil is suited to corn, sorghum, alfalfa, and small grain. Water erosion is a severe hazard in cultivated areas. Terraces, contour farming, and grassed waterways help to control runoff and reduce the hazard of erosion. Keeping crop residue on the surface and applying a system of conservation tillage, such as disking or chiseling, that keeps crop residue on the surface help to control erosion and conserve moisture.

If irrigated, this soil is suited to corn, sorghum, alfalfa, small grain, and introduced grasses. It is better suited to close-sown crops than to row crops. All types of irrigation are suitable. If a gravity system is used, however, land leveling is needed to obtain a uniform distribution of water. Water erosion is the principal hazard. Maintaining fertility and properly distributing the irrigation water are management concerns. Terraces, contour irrigation, grassed waterways, and a protective cover of crops or crop residue help to control erosion. The rate at which irrigation water is applied should not exceed the intake rate of the soil. A cover of crop residue increases the water intake rate and reduces the hazard of erosion.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by big bluestem, indiangrass, little bluestem, sideoats grama, and switchgrass. These species make up 70 percent or more of the total annual production. Blue grama, western wheatgrass, buffalograss, needleandthread, prairie junegrass, Scribner panicum, leadplant, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, little bluestem, prairie junegrass, indiangrass, and switchgrass decrease in abundance. Initially, these species are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. Under these conditions, excessive water erosion and soil blowing occur.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture. In areas where gullies have formed because of severe water erosion, land shaping and deferred grazing are needed to stabilize the site.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the grasses to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as farmstead, feedlot, and field windbreaks and as plantings that enhance recreational areas and wildlife habitat. Inadequate seasonal rainfall and competition from grasses and weeds are the principal concerns in establishing and managing the trees and shrubs. Water erosion also is a concern. Irrigation is needed during periods of low rainfall. Trickle or drip watering systems are especially effective methods of watering trees. Cultivating between the tree rows with conventional equipment and applying appropriate herbicides help to control the undesirable weeds and grasses that compete with the trees and shrubs for moisture. Planting on the contour and terracing help to control erosion.

This soil is suitable as a site for septic tank absorption fields and dwellings. Seepage is a hazard on sites for sewage lagoons. It can be controlled by lining or sealing

the lagoon. The sides of shallow excavations can cave in unless they are temporarily shored. The damage to local roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIIe-9, dryland, and IIIe-6, irrigated; Silty range site; windbreak suitability group 3.

GfD—Gates very fine sandy loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on side slopes and along drainageways in the uplands. Some areas are hummocky. The soil formed in reworked or recently deposited loess. Areas range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 5 inches thick. The transition layer is brown, very friable very fine sandy loam about 13 inches thick. The underlying material to a depth of more than 60 inches is very fine sandy loam. It is pale brown in the upper part, pale yellow in the next part, and light gray in the lower part. Lime is at a depth of about 18 inches. In places the surface layer is fine sandy loam. In some areas carbonates are at the surface. In other areas the entire profile is noncalcareous.

Included with this soil in mapping are small areas of Hobbs, Hersh, and Valentine soils. Hobbs soils have a surface layer that is darker and thicker than that of the Gates soil. They are on bottom land along the larger drainageways. Hersh and Valentine soils contain more sand than the Gates soil. Hersh soils are in positions on the landscape similar to those of the Gates soil. Valentine soils are in the higher positions and are excessively drained. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Gates soil, and the available water capacity is high. Organic matter content is low. The water intake rate is moderate. Runoff is medium. Because of the low organic matter content, the soil puddles if it is worked when too wet.

About half of the acreage of this soil is cropland, and half is range. Some areas that formerly were farmed have been reseeded to grasses.

This soil is poorly suited to dryland crops. It is better suited to alfalfa and small grain than to row crops. Alfalfa and small grain grow and mature in spring, when the amount of rainfall is highest. Water erosion is a severe hazard in cultivated areas. It can be controlled by terraces, contour farming, and grassed waterways. A system of conservation tillage, such as disking and chiseling, that leaves significant amounts of crop residue on the surface after planting conserves moisture, improves tilth, and helps to control erosion and runoff.

If irrigated, this soil is suited to alfalfa, small grain, and introduced grasses. It is poorly suited to row crops because the hazard of erosion is severe. A sprinkler system is the only suitable method of irrigation. Controlling erosion is difficult because of the combined effects of rainfall and irrigation water. The water should be applied in sufficient amounts to meet the needs of the crop and at a rate that permits maximum absorption and results in minimum runoff. Terraces, grassed waterways, and a mulch of crop residue help to control erosion and conserve moisture.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by big bluestem, indiangrass, little bluestem, sideoats grama, and switchgrass. These species make up 70 percent or more of the total annual production. Blue grama, western wheatgrass, buffalograss, needleandthread, prairie junegrass, Scribner panicum, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, indiangrass, and switchgrass decrease in abundance. Initially, these species are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. Under these conditions, excessive water erosion and soil blowing occur.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture. In areas where gullies have formed because of severe water erosion, land shaping and deferred grazing are needed to stabilize the site.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter

range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. Drought and water erosion are the main hazards. Supplemental water is needed during periods of low rainfall. Planting on the contour and terracing help to prevent excessive erosion and runoff. Growth may be somewhat slower on the steepest slopes. Competition for moisture from grasses and weeds can be controlled by cultivating between the tree rows with conventional equipment and by applying carefully selected herbicides in the rows. Annual cover crops can be grown between the rows. The areas in the row or near small trees can be hoed by hand or rototilled.

This soil is suitable as a site for septic tank absorption fields where the slope is less than 8 percent. Where the slope is more than 8 percent, land shaping is needed and the field should be installed on the contour. On sites for sewage lagoons, grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage.

The sides of shallow excavations in this soil can cave in unless they are temporarily shored. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to an acceptable gradient. The damage to local roads and streets caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage. In some areas cutting and filling are needed to provide a suitable grade.

The land capability units are IVe-9, dryland, and IVe-6, irrigated; Silty range site; windbreak suitability group 3.

Gk—Gibbon loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom land along the major streams and rivers. It is occasionally flooded for very brief periods. It formed in alluvium. Areas are 10 to 80 acres in size.

Typically, the surface layer is gray, friable loam about 5 inches thick. The subsurface layer is friable loam about 15 inches thick. It is dark gray in the upper part and dark grayish brown in the lower part. The transition layer is light brownish gray loam about 6 inches thick. It has a few yellowish brown mottles. The underlying material extends to a depth of more than 60 inches. It is light gray loam in the upper part; gray, mottled very fine sandy loam in the next part; and light gray, mottled fine sandy loam in the lower part. The soil is calcareous throughout. In places the surface layer is fine sandy loam or silt loam.

Included with this soil in mapping are small areas of Hord and Ord soils. Hord soils are deeper to carbonates than the Gibbon soil. Also, they are higher on the landscape. Ord soils are in positions on the landscape similar to those of the Gibbon soil. They contain more sand throughout than the Gibbon soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Gibbon soil, and the available water capacity is high. Organic matter content is moderate. The water intake rate also is moderate. Runoff is slow. The depth to the seasonal high water table ranges from 1.5 feet in wet years to 3.0 feet in dry years. Tilth is good.

Most of the acreage of this soil is farmed. A few areas are used for range or hay.

If used for dryland farming, this soil is suited to corn, grain sorghum, wheat, oats, and alfalfa. Because of poor surface drainage and the seasonal high water table, fieldwork may be delayed and the soil may be slow to warm up in the spring. If the wetness persists into the growing season, crops may be damaged. Growing alfalfa and winter wheat eliminates the need for tillage in the spring. Land leveling improves surface drainage, and tile or open ditches can lower the water table if suitable outlets are available.

If irrigated, this soil is suited to corn, grain sorghum, and alfalfa. Gravity or sprinkler systems can be used. Efficient water management is needed. Land leveling can improve surface drainage. Also, it establishes a suitable grade for gravity systems. Tile generally is not needed in irrigated areas, but the water table can be a problem during wet periods. If suitable outlets are available, drainage ditches or tile drains can lower the water table.

This soil is suited to pasture and hay. A cover of grasses and legumes is effective in controlling soil blowing. Delaying grazing or haying until the surface is dry enough helps to prevent compaction and the formation of small mounds, which hinder subsequent grazing and haying. Forage production can be increased by growing a mixture of grasses and legumes.

If this soil is used for range, the climax vegetation is dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges and rushes. These species make up 80 percent or more of the total annual production. Plains bluegrass, slender wheatgrass, western wheatgrass, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, foxtail barley, slender wheatgrass, green muhly, and various sedges and rushes. Timothy, redtop, and clover also increase in abundance if they have been overseeded. If overgrazing

or improper haying continues for many years, bluegrass, sedges, rushes, clover, and other forbs, such as Baldwin ironweed, dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 1.7 animal unit months per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with better drained, sandy soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If this soil is used as hayland, the forage should be harvested only every other year. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the maximum storage of these food reserves is completed by the frost period. The quality of the hay is higher when the grasses are cut earlier. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed before the frost leaves the soil in the spring. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. The species that can withstand occasional wetness survive and grow well. Competition from grasses and weeds is the principal concern in establishing trees. The weeds and grasses between the tree rows can be controlled by cultivation and by appropriate herbicides. Spring planting may be delayed because of the wetness.

This soil is generally unsuitable as a site for septic tank absorption fields, sewage lagoons, and dwellings because of the occasional flooding and the wetness. Constructing local roads on suitable, well compacted fill material above the level of flooding and providing adequate side ditches and culverts help to prevent the road damage caused by flooding. The damage caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIw-4, dryland, and IIw-6, irrigated; Subirrigated range site; windbreak suitability group 2S.

HaB—Hall silt loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is on ridgetops in the uplands. It formed in loess. Areas range from 5 to 50 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 26 inches thick. It is dark grayish brown, firm silt clay loam in the upper part and brown, friable silt loam in the lower part. The underlying material to a depth of about 60 inches is very pale brown, calcareous silt loam. Free carbonates are at a depth of about 44 inches. In some areas the soil is dark to a depth of less than 20 inches. In other areas the subsoil is not so well expressed.

Included with this soil in mapping are small areas of Uly soils. These soils are lower on the landscape than the Hall soil. Also, they have a thinner surface soil and have less clay in the subsoil. They make up about 10 percent of the unit.

Permeability is moderate in the Hall soil, and the available water capacity is high. Organic matter content is moderate. The water intake rate is moderately low. Runoff is slow.

Most of the acreage of this soil is cropland. The rest supports native grasses and is used as range. Some of the cropland is irrigated.

If used for dryland farming, this soil is suited to corn, sorghum, small grain, and alfalfa. Water erosion is a hazard unless the surface is protected by crops or crop residue. A conservation tillage system that leaves crop residue on the surface helps to control erosion and conserves moisture. Terraces, contour farming, and grassed waterways also help to control erosion. Returning crop residue to the soil and applying barnyard manure improve tilth and increase the organic matter content and the available water capacity.

If irrigated, this soil is suited to corn, sorghum, small grain, alfalfa, and introduced grasses. Gravity or sprinkler irrigation systems can be used. Less land preparation is needed if a sprinkler system is used. Water erosion and soil blowing are hazards unless the surface is protected. They can be controlled by a conservation tillage system, such as disking and till-planting, that leaves crop residue on the surface. Adjusting the rate at which the water is applied to the intake rate of the soil helps to prevent excessive runoff and erosion. Grassed waterways, contour farming, and level bench terraces also help to control erosion. Returning crop residue to the soil and adding barnyard manure increase the water intake rate and the available water capacity and improve fertility. A tailwater recovery system conserves water.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by little bluestem, big bluestem, western wheatgrass, blue grama, and sideoats grama. These species make up 70 percent or more of the total annual production. Switchgrass, buffalograss, needleandthread, prairie junegrass, Scribner panicum, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance. Initially, these species are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose plant vigor and are unable to stabilize the site. Under those conditions, excessive water erosion and soil blowing occur.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Because it is very gently sloping, this soil tends to be overused when grazed in conjunction with steeper, silty soils. Livestock also tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland generally can be reseeded to native grasses if a proper seedbed is prepared and a suitable mixture of grass seed is selected for planting.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. A scarcity of seasonal rainfall is the main problem. Irrigation is needed during dry periods. Competition from weeds and undesirable grasses can be controlled by cultivating with conventional equipment or by applying appropriate herbicides. Areas in the tree rows or near small trees can be hoed by hand or rototilled.

This soil is suitable as a site for septic tank absorption fields. Seepage is a hazard on sites for sewage lagoons. It can be controlled by lining or sealing the lagoon. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling of the soil. Local roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

The land capability units are IIe-1, dryland, and IIe-4, irrigated; Silty range site; windbreak suitability group 3.

HeB—Hersh fine sandy loam, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, well drained soil is on uplands. It formed in mixed sandy and loamy eolian material. Areas range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 6 inches thick. The transition layer is light brownish gray, very friable fine sandy loam about 8 inches thick. The underlying material extends to a depth of more than 60 inches. It is pale brown fine sandy loam in the upper part, pale brown very fine sandy loam in the next part, and very pale brown fine sand in the lower part. In places the surface layer is silt loam, very fine sandy loam, or loamy fine sand. In some areas the transition layer is silt loam or very fine sandy loam. In other areas loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Gates and Valentine soils. Gates soils are in positions on the landscape similar to those of the Hersh soil. They are finer textured than the Hersh soil. Valentine soils are in the higher positions on the landscape. They contain more sand than the Hersh soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Hersh soil, and the available water capacity is moderate. Organic matter content is low. The water intake rate is moderately high. Runoff is slow. The soil can be easily tilled throughout a wide range of moisture content.

A large acreage of this soil is used for cultivated crops. Some supports native grasses and is used as range or hayland.

If used for dryland farming, this soil is suited to corn, alfalfa, sorghum, and small grain. Soil blowing is a hazard. Stubble mulch tillage, stripcropping, and a cropping system that maintains a cover of crops or crop residue help to control soil blowing and conserve moisture. A cropping sequence that includes legumes, grasses, or a mixture of both increases the organic matter content, helps to maintain fertility, and reduces the susceptibility to soil blowing. Row crops can be alternated with small grain and legumes in the crop rotation.

If irrigated, this soil is suited to corn, alfalfa, small grain, sorghum, and introduced grasses. Some land shaping may be necessary if a gravity system is used. Cuts should not expose the sandy underlying material. A sprinkler system is the best method of irrigation because land leveling is not needed in areas irrigated by sprinklers and because light, frequent applications of water are needed. One large application can result in the leaching of plant nutrients below the root zone. Returning crop residue to the soil and applying a system of conservation tillage, such as chiseling, disking, and till planting, help to control erosion and maintain fertility. Growing cover crops or leaving crop residue on the surface throughout the winter helps to control soil blowing. Adding barnyard manure increases the organic matter content and improves fertility.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual production. Switchgrass, blue grama, sand dropseed, indiangrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, bluegrass, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with Sands or Choppy Sands range sites. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to a suitable grass mixture if a proper seedbed is prepared and a suitable cover crop is grown for 2 or more years.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. A scarcity of moisture and the hazard of soil blowing are the principal concerns in establishing trees. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation generally should be restricted to the tree rows. Irrigation is needed during dry periods. Weeds and undesirable grasses in the tree rows can be controlled by timely applications of appropriate herbicide. Otherwise, the areas in the rows can be hoed by hand or rototilled.

This soil is suitable as a site for septic tank absorption fields and dwellings. Seepage is a hazard on sites for sewage lagoons. It can be controlled by lining or sealing the lagoon. The sides of shallow excavations can cave in unless they are temporarily shored. The damage to local roads and streets caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIIe-3, dryland, and IIe-8, irrigated; Sandy range site; windbreak suitability group 5.

Hk—Hobbs silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is along upland drainageways and on bottom land along intermittent drainageways. It is occasionally flooded for brief periods. It formed in silty alluvium. Areas are generally long and narrow and range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 5 inches thick. The subsurface layer is grayish brown, friable silt loam about 2 inches thick. The underlying material to a depth of more than 60 inches is stratified grayish brown and light brownish gray silt loam and very fine sandy loam. In some areas the surface layer is stratified with sandy and loamy material. In places carbonates are within 10 inches of the surface.

Included with this soil in mapping are small areas of Hord soils. These soils are in the higher landscape positions. They are not stratified in the upper part. Also included are a few small areas that are frequently flooded. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Hobbs soil, and the available water capacity is high. Organic matter content is moderate. Runoff is slow.

About half of the acreage of this soil is range, and half is cropland. Some small areas are irrigated by sprinklers.

If used for dryland farming, this soil is suited to corn, sorghum, small grain, and alfalfa. The flooding is the principal hazard. It can damage alfalfa and small grain. During dry periods, however, the crops benefit from the additional water. Diversion terraces and dikes can intercept runoff and keep it from spreading over a wide area. Open drainage ditches also may be effective. A system of conservation tillage that keeps crop residue on the surface conserves moisture and helps to control soil blowing.

If irrigated, this soil is suited to corn, alfalfa, sorghum, and introduced grasses. It is suitable for both gravity and sprinkler systems. Land leveling is generally needed if a gravity system is used. Terraces and diversions on the adjacent soils can intercept runoff from the higher areas. A system of conservation tillage that keeps crop residue on the surface conserves moisture and helps to control soil blowing.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by big bluestem, western wheatgrass, little bluestem, switchgrass, and sideoats grama. These species make up 70 percent or more of the total annual production. Prairie junegrass, green needlegrass, Kentucky bluegrass, blue grama, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and green needlegrass decrease in abundance. Initially, these species are replaced by western wheatgrass, Kentucky bluegrass, and sedges. If overgrazing continues for many years on the surrounding soils, the protective plant cover on these soils is depleted. As a result, runoff is rapid onto this soil. The flooding results in sedimentation, channeling, and the deposition of debris and weed seeds. Deferment of grazing after the period of flooding helps to prevent compaction.

If the range is in excellent condition, the suggested initial stocking rate is 1.2 animal unit months per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If this soil is used as hayland, the forage should be harvested annually. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. A mowing height of more than 3 inches helps to maintain a good stand and high forage production.

This soil is suited to the trees and shrubs grown as windbreaks. Competition from weeds and undesirable grasses can be controlled by good site preparation, timely cultivation, and applications of appropriate herbicide. The areas in the tree rows can be rototilled or hoed by hand. Some areas should be protected against flooding until the trees are established.

This soil is unsuitable as a site for septic tank absorption fields and dwellings because of the flooding. A suitable alternative site is needed. Because of the flooding, sewage lagoons should be diked. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarse grained base material helps to ensure better performance. Constructing the roads on suitable, well compacted fill material above the level of flooding and providing adequate side ditches and culverts help to prevent the road damage caused by floodwater.

The land capability units are IIw-3, dryland, and IIw-6, irrigated; Silty Overflow range site; windbreak suitability group 1.

HtB—Hord silt loam, terrace, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is on stream terraces along the Cedar River and its tributaries. The soil formed in alluvium. It is subject to rare flooding.

Areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 5 inches thick. The subsurface layer also is dark grayish brown, very friable silt loam. It is about 17 inches thick. The subsoil is friable silt loam about 26 inches thick. It is grayish brown in the upper part, dark grayish brown in the next part, and brown in the lower part. The underlying material to a depth of more than 60 inches is pale brown silt loam. In some areas the surface layer is thinner. In other areas the subsoil has a higher content of clay.

Included with this soil in mapping are small areas of Hobbs soils. These soils have no subsoil. They are on bottom land. They make up 5 to 15 percent of the unit.

Permeability is moderate in the Hord soil, and the available water capacity is high. Organic matter content is moderate. The water intake rate also is moderate. Runoff is slow. The soil can be easily worked. It releases water readily to plants.

Most areas of this soil are used for irrigated crops. The rest are used for dryland crops or for range.

If used for dryland farming, this soil is suited to corn, small grain, sorghum, and introduced grasses and legumes. Measures that conserve moisture and control water erosion and soil blowing are the main management needs. An example is a system of conservation tillage, such as disking and chiseling, that leaves crop residue on the surface. If left standing throughout the winter, crop stubble traps snow and thus increases the moisture supply. It also helps to control runoff. Returning crop residue and green manure crops to the soil and applying barnyard manure increase the organic matter content and the water intake rate and improve fertility and tilth.

If irrigated, this soil is suited to corn, sorghum, small grain, alfalfa, and introduced grasses. Both gravity and sprinkler irrigation systems can be used. Land leveling is generally needed to obtain a proper grade for gravity irrigation. Water erosion occurs if the application rate exceeds the moderate intake rate of the soil. Applying an excessive amount of water can result in the leaching of plant nutrients below the root zone. Tailwater recovery systems conserve water and improve the efficiency of the irrigation system. A system of conservation tillage that leaves crop residue on the surface conserves moisture and helps to control erosion.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by big bluestem, little bluestem, switchgrass, sideoats grama, and western wheatgrass. These species make up 70 percent or more of the total annual production. Blue grama, buffalograss, indiangrass, tall dropseed, Kentucky bluegrass, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, indiangrass, sideoats grama, and switchgrass decrease in abundance. Initially, these species are replaced by Kentucky bluegrass, western wheatgrass, and tall dropseed. If overgrazing continues for many years, bluegrass, buffalograss, Scribner panicum, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.2 animal unit months per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. This is generally the first soil to be overgrazed when it is grazed in conjunction with steeper soils that are in the Limy Upland or Thin Loess range sites. The areas away from watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture.

If this soil is used as hayland, the forage should be harvested only every other year. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. An insufficient amount of rainfall is the main problem. Seedlings survive and grow well only if competing weeds and grasses are controlled or removed. Plant competition can be controlled by good site preparation, by timely cultivation, or by applications of appropriate herbicide in the tree rows.

The hazard of flooding should be considered before this soil is used as a site for sanitary facilities or dwellings. On sites for sewage lagoons, grading is needed to modify the slope and shape of the lagoon. Dwellings can be constructed on elevated, well compacted fill material, which helps to protect the site

against flooding. Lining or sealing sewage lagoons helps to prevent seepage. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarse grained base material helps to ensure better performance.

The land capability units are IIe-1, dryland, and IIe-6, irrigated; Silty Lowland range site; windbreak suitability group 1.

IfB—Ipage fine sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, moderately well drained soil is on low hummocks and ridges on stream terraces in broad valleys near the sandhills. It formed in sandy eolian and alluvial material. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sand about 7 inches thick. The transition layer is grayish brown, very friable fine sand about 5 inches thick. The underlying material to a depth of more than 60 inches is fine sand. It is light brownish gray in the upper part and very pale brown in the lower part. It has yellowish brown mottles at a depth of about 26 inches. In places the surface layer is sand or loamy sand. In a few areas coarse sand or gravelly coarse sand is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Els, Tryon, and Valentine soils. Els and Tryon soils are in the lower positions on the landscape. Els soils are somewhat poorly drained, and Tryon soils are poorly drained and very poorly drained. Valentine soils are on the higher, steeper ridges and knolls and are excessively drained. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Ipage soil, and the available water capacity is low. Organic matter content also is low. The water intake rate is very high. Runoff is slow. The depth to the seasonal high water table ranges from about 3 feet in wet years to 6 feet in dry years.

Most of the acreage is used as range or hayland. A few areas are used as irrigated cropland. This soil is unsuited to dryland crops because of droughtiness and the hazard of soil blowing.

If irrigated by sprinklers, this soil is suited to corn, alfalfa, and introduced grasses. It is unsuitable for gravity methods of irrigation because the water should be applied frequently and in small amounts. One large application can result in excessive leaching of plant nutrients. Planting winter cover crops and close-growing crops and leaving crop residue on the surface help to control soil blowing. Applying barnyard manure helps to maintain fertility and increases the organic matter content.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. These species make up 75 percent or more of the total annual production. Kentucky bluegrass, blue grama, sand dropseed, prairie junegrass, indiangrass, Scribner panicum, leadplant, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance. Initially, these species are replaced by prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, bluegrass, Scribner panicum, sand dropseed, needleandthread, sedges, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.0 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing (fig. 10). Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing. Abandoned cropland generally can be reseeded to native grasses if a proper seedbed is prepared, a suitable cover crop is grown for 2 or more years, and a suitable seed mixture is selected for planting.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. It is so loose, however, that seedlings should be planted in shallow furrows and the site should not be cultivated. The seedlings can be damaged by

Figure 10.—A livestock well in an area of Ipage fine sand, 0 to 3 percent slopes.

windblown sand. Strips of sod or cover crops between the tree rows help to control soil blowing. Areas near the trees can be hoed by hand.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in contamination of ground water. Fill material can elevate absorption fields and the bottom of sewage lagoons a sufficient distance above the seasonal high water table. Lining or sealing the lagoons helps to prevent seepage.

The sides of shallow excavations in this soil can cave in unless they are temporarily shored. The soil is suitable as a site for dwellings without basements. Dwellings with basements should be constructed on raised, well compacted fill material, which helps to overcome the wetness caused by the seasonal high water table. The damage to local roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are VIe-5, dryland, and IVe-12, irrigated; Sandy lowland range site; windbreak suitability group 7.

IgB—Ipage loamy sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, moderately well drained soil is mainly on stream terraces and in

sandhill valleys, but it also is in upland areas where eolian sand is underlain by clayey and loamy material. The soil formed in sandy eolian and alluvial material. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 4 inches thick. The transition layer is grayish brown, very friable loamy sand about 7 inches thick. The underlying material to a depth of more than 60 inches is fine sand. It is pale brown in the upper part and very pale brown in the lower part. It has yellowish brown mottles below a depth of 32 inches. In some areas the surface layer is 10 to 18 inches thick. In a few places coarse sand or gravelly coarse sand is at a depth of 20 to 40 inches. In a few areas clayey or loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Elsmere, Loup, and Valentine soils. Elsmere and Loup soils are on the lower parts of the landscape. Elsmere soils are somewhat poorly drained, and Loup soils are poorly drained and very poorly drained. Valentine soils are in the higher landscape positions and are excessively drained. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Ipage soil, and the available water capacity is low. Organic matter content also is low. The water intake rate is very high. Runoff is slow. The depth to the seasonal high water table ranges from about 3 feet in wet years to 6 feet in dry years.

Most of the acreage of this soil is used as range or hayland. A small acreage is used as cropland.

If used for dryland farming, this soil is poorly suited to corn, soybeans, small grain, and alfalfa. Small grain and the first cutting of alfalfa are generally the most dependable crops because they grow and mature in the spring, when the amount of rainfall is higher. Soil blowing is a hazard. Windblown sand sometimes destroys young seedlings early in the spring. A cropping system that maintains a cover of crops, grasses, or crop residue helps to control soil blowing, conserves moisture, and helps to maintain the organic matter content and fertility.

If irrigated, this soil is suited to corn, soybeans, small grain, alfalfa, and introduced grasses. A sprinkler system is the best method of irrigation. Frequent applications of irrigation water are needed because the available water capacity is low. Also, the applications should be light. A large application can result in excessive leaching of plant nutrients. Returning crop residue to the soil and applying barnyard manure increase the organic matter and improve fertility. Leaving crop residue on the surface helps to control soil blowing.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by sand bluestem, prairie sandreed, little bluestem, needleandthread, and switchgrass. These species make up 75 percent or more of the total annual production. Blue grama, Kentucky bluegrass, prairie junegrass, sand dropseed, indiangrass, Scribner panicum, leadplant, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, bluegrass, Scribner panicum, sand dropseed, needleandthread, sedges, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.0 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing. Abandoned cropland generally can be reseeded to native grasses if a proper seedbed is prepared, a suitable cover crop is grown for 2 or more years, and a suitable seed mixture is selected for planting.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. Soil blowing is a hazard. It can be controlled by maintaining strips of sod or other vegetation between the tree rows. Drought and competition for moisture from grasses and weeds are management concerns. Irrigation is needed during dry periods. Weeds and grasses can be controlled by cultivation or by applications of herbicide.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in contamination of ground water. Fill material can elevate absorption fields and the bottom of sewage lagoons a sufficient distance above the seasonal high water table. Lining or sealing the lagoons helps to prevent seepage.

The sides of shallow excavations in this soil can cave in unless they are temporarily shored. The soil is well suited to dwellings without basements. Dwellings with basements should be constructed on raised, well compacted fill material, which helps to overcome the wetness caused by the seasonal high water table. The damage to local roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IVe-5, dryland, and IVe-11, irrigated; Sandy Lowland range site; windbreak suitability group 5.

LfB—Libory loamy fine sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, moderately well drained soil is on stream terraces. It formed in sandy eolian material over loamy alluvium or loess. Areas range from 5 to 150 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 5 inches thick. The subsurface layer is dark grayish brown, very friable loamy fine sand about 8 inches thick. The next layer is pale brown, mottled, loose fine sand about 12 inches thick. The subsoil is light brownish gray, friable silt clay loam about 17 inches thick. The underlying material to a depth of 60 inches or more is light gray, mottled silt loam. In places the sandy material is less than 20 or more than 36 inches deep over the silty material.

Included with this soil in mapping are small areas of Dunday, Els, Ipage, and Valentine soils, which are sandy throughout. Dunday soils are in the higher landscape positions. Els soils are in the lower positions and are somewhat poorly drained. Ipage soils are in landscape positions similar to those of the Libory soil. Valentine soils are in the higher positions and are excessively drained. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the upper part of the Libory soil and moderate or moderately slow in the lower part. The available water capacity is moderate. Organic matter content is moderately low. The water intake rate is high. Runoff is slow. The depth to a perched seasonal high water table ranges from about 1.5 feet in wet years to 3.0 feet in dry years. The soil can be easily tilled.

Most of the acreage of this soil is farmed. The rest is used as range or hayland. Many areas are irrigated.

If used for dryland farming, this soil is suited to corn, grain sorghum, small grain, and alfalfa. Small grain and the first cutting of alfalfa are generally more dependable than row crops because they grow and mature in the spring, when the amount of rainfall is highest. Soil blowing is a hazard unless the surface is protected by crops or crop residue. Other management concerns are conserving moisture and maintaining the organic matter content and fertility. A system of conservation tillage, such as disking, chiseling, no-till planting, and stubble mulching, helps to control soil blowing and conserves moisture. Stripcropping also helps to control soil blowing. Returning crop residue to the soil improves tilth and increases the organic matter content and the rate of water intake. The silty subsoil holds moisture, which helps dryland crops to withstand droughty conditions.

If irrigated, this soil is suited to corn, sorghum, alfalfa, and introduced grasses. Both gravity and sprinkler irrigation are suitable. Generally, some leveling is needed if a gravity system is used. Less land preparation is needed if a sprinkler system is used. In periods of above normal rainfall, the wetness caused by the perched water table can be a problem in some areas. Soil blowing is a hazard unless the surface is protected by crops or crop residue. A system of conservation tillage, such as disking, chiseling, and no-till planting, helps to control soil blowing and conserves moisture. Light, frequent applications of irrigation water are necessary. One large application can result in ponding in areas where the perched water table is near the surface.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by big bluestem, little bluestem, switchgrass, indiangrass, and plains bluegrass. These species make up 75 percent or more of the total annual production. Blue grama, sand dropseed, needleandthread, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, indiangrass, sand lovegrass, little bluestem, and switchgrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, blue grama, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.0 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to

maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trials. The areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing. Abandoned cropland generally can be reseeded to native grasses if a proper seedbed is prepared, a suitable cover crop is grown for 2 or more years, and a suitable seed mixture is selected for planting.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is well suited to the trees and shrubs grown as farmstead, feedlot, and field windbreaks and as plantings that enhance recreational areas and wildlife habitat. Soil blowing and competition for moisture from weeds and grasses are the principal concerns in establishing and managing the trees and shrubs. Soil blowing can be controlled by maintaining strips of sod or other cover crops between the tree rows. Undesirable weeds and grasses can be controlled by applying appropriate herbicides both before and after planting and by hand hoeing. Supplemental water is needed during periods of insufficient rainfall.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Fill material can elevate absorption fields and the bottom of sewage lagoons a sufficient distance above the water table. Lining or sealing the lagoon helps to prevent seepage.

The sides of shallow excavations in this soil can cave in unless they are temporarily shored. The excavations should be made during dry periods. Dwellings should be constructed on raised, well compacted fill material, which helps to overcome the wetness caused by the perched water table. Constructing local roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the road damage caused by wetness.

The land capability units are IIIe-6, dryland, and IIIe-10, irrigated; Sandy Lowland range site; windbreak suitability group 5.

Ln—Loretto loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on uplands and stream terraces. It formed in loamy and silty eolian material. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 7 inches thick. The subsurface layer also is dark grayish brown, friable loam. It is about 6 inches thick. The subsoil is about 17 inches thick. The upper part is grayish brown, friable clay loam; the next part is brown, firm silty clay loam; and the lower part is pale brown, friable silt loam. The underlying material to a depth of more than 60 inches is very pale brown silt loam. In some areas the surface layer is fine sandy loam. In other areas the surface soil is 20 to 26 inches thick. In a few areas fine sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Anselmo, Boelus, Dunday, and Uly soils. Anselmo and Boelus soils are in landscape positions similar to those of the Loretto soil. Anselmo soils have more sand in the subsoil than the Loretto soil. Boelus soils have a sandy surface layer. The well drained, sandy Dunday soils are in the slightly higher landscape positions. Uly soils are in the slightly lower positions. They are silty throughout. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Loretto soil, and the available water capacity is high. Organic matter content is moderate. The water intake rate is moderately low. Runoff is slow. The surface layer can be easily tilled. The soil readily releases moisture to plants.

Most of the acreage of this soil is used for cultivated crops. A few small areas are used as range or hayland.

If used for dryland farming, this soil is suited to corn, sorghum, alfalfa, soybeans, small grain, and introduced grasses. Insufficient precipitation is the major problem. Soil blowing and water erosion are hazards. Small grain and the first cutting of alfalfa are more dependable than row crops because they grow and mature in the spring, when the amount of rainfall is higher. Sorghum is better suited than corn. A cropping system that maintains a cover of crops or crop residue helps to prevent excessive soil loss. A system of conservation tillage, such as no-till planting of row crops and disking or chiseling, helps to prevent excessive soil blowing and conserves moisture. Stripcropping and field windbreaks also help to control soil blowing. Returning crop residue to the soil increases the organic matter content and improves fertility and tilth.

If irrigated, this soil is suited to corn, alfalfa, soybeans, and introduced grasses. It is suitable for a sprinkler system of irrigation. It also is suitable for a gravity system, but leveling is needed. Soil blowing is the principal hazard. No-till planting of row crops, disking,

chiseling, or other systems of conservation tillage that keep crop residue on the surface help to control soil blowing and conserve moisture. Applying barnyard manure increases the organic matter content and improves fertility.

This soil is suited to introduced grasses for pasture and hay. Cool-season grasses, such as smooth brome, orchardgrass, and tall fescue, can be grown in a mixture with alfalfa. Forage production can be increased or maintained by proper stocking rates and rotation grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by big bluestem, little bluestem, indiangrass, sideoats grama, switchgrass, and western wheatgrass. These species make up 70 percent or more of the total annual production. Buffalograss, needleandthread, prairie junegrass, Scribner panicum, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance. Initially, these species are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. Under these conditions, excessive water erosion and soil blowing occur.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture. In areas where gullies have formed because of severe water erosion, land shaping and deferred grazing are needed to stabilize the site.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is well suited to the trees and shrubs grown as farmstead, feedlot, and field windbreaks and as plantings that enhance recreational areas and wildlife habitat. Competition from grasses and weeds is the principal concern in establishing and managing the trees and shrubs. It can be controlled by cultivation between the tree rows and by applications of carefully selected herbicide.

This soil is suitable as a site for septic tank absorption fields and dwellings. Seepage is a hazard on sites for sewage lagoons. It can be controlled by sealing or lining the lagoon. Local roads should be designed so that surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

The land capability units are IIc-1, dryland, and I, irrigated; Silty range site; windbreak suitability group 3.

Lo—Loup fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is on valley floors in the sandhills and on bottom land along drainageways. It formed in sandy alluvial material. It is subject to rare flooding. Areas range from 5 to more than 1,000 acres in size.

Typically, the surface layer is dark gray, very friable fine sandy loam about 6 inches thick. The subsurface layer is friable and very friable fine sandy loam about 10 inches thick. It is very dark gray in the upper part and dark gray in the lower part. The transition layer is gray, loose fine sand about 10 inches thick. It has brown mottles. The underlying material to a depth of more than 60 inches is light gray fine sand. It has distinct, yellowish brown mottles. In some places a thin layer of silty clay loam is in the lower part of the surface layer. In other places the surface layer is less than 10 inches thick. In some areas the transition layer is sandy loam to silt loam. In some areas near the sandhills, a thin layer of light colored fine sand is at the surface. In a few places the underlying material is finely stratified with sandy and loamy material.

Included with this soil in mapping are small areas of Elsmere and Marlake soils. Elsmere soils are in the higher landscape positions and are somewhat poorly drained. Marlake soils are in the lower positions and are subject to ponding. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Loup soil, and the available water capacity is low. Organic matter content is high. Runoff is very slow. The seasonal high water table is near the surface in wet years and is within a depth of about 1.5 feet in dry years. The soil is covered with water for a few days in the spring and during other extremely wet periods. The water table usually drops to a depth of 2 to 3 feet by later summer.

This soil supports native grasses and is used for range or hay (fig. 11). It usually is too wet to be used as cropland. The climax vegetation is dominated by switchgrass, indiangrass, prairie cordgrass, big bluestem, northern reedgrass, and various sedges and rushes. These species make up 75 percent or more of the total annual production. Plains bluegrass, slender wheatgrass, Canada wildrye, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, bluejoint reedgrass, northern reedgrass, prairie cordgrass, switchgrass, indiangrass, and reed canarygrass decrease in abundance. Initially, these species are replaced by slender wheatgrass, western wheatgrass, plains muhly, and various sedges. Timothy, redtop, and clover also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, western wheatgrass, foxtail barley, and various sedges, rushes, and forbs dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 1.9 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities. The areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with better drained, sandy soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the

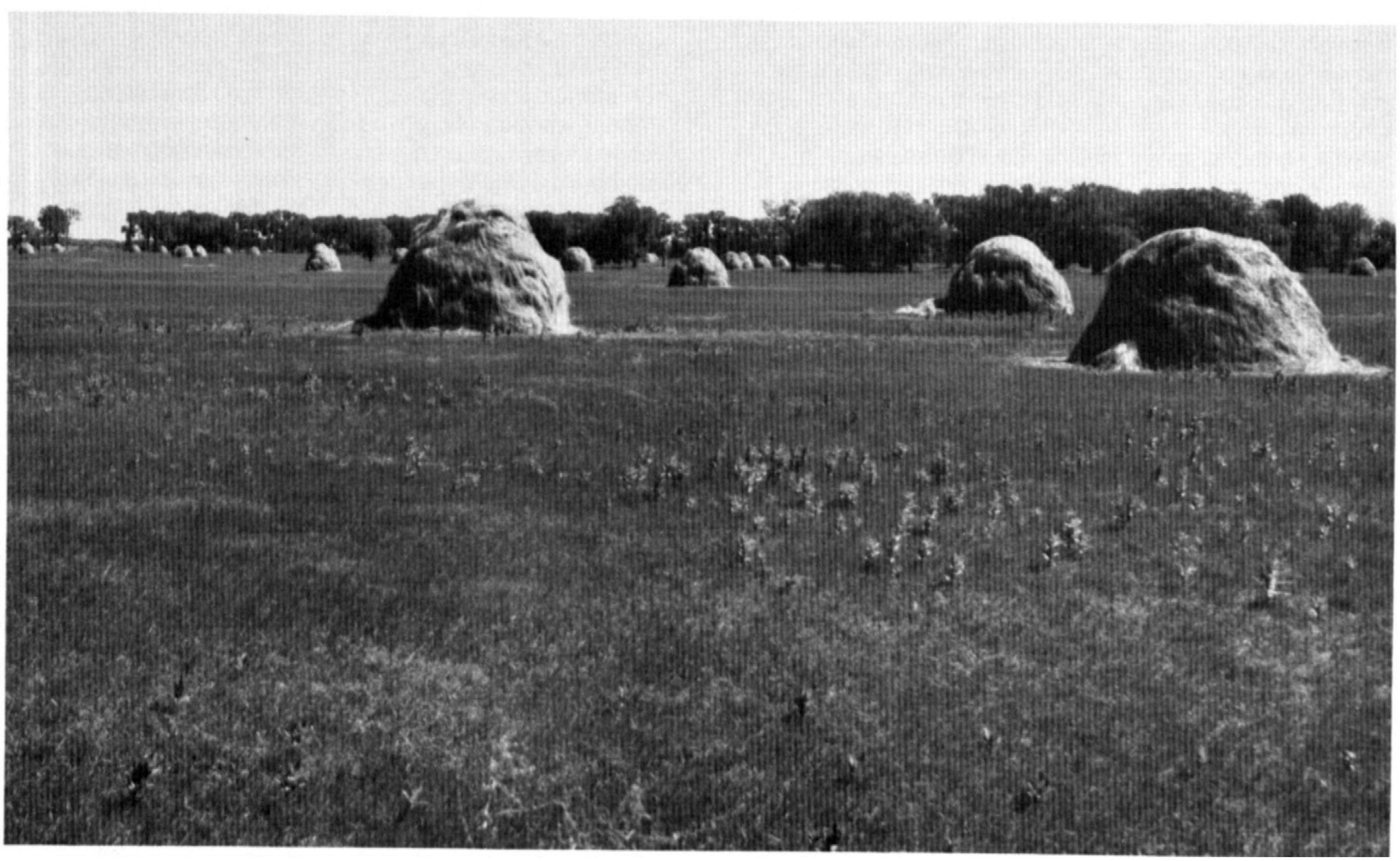

Figure 11.—An area of Loup fine sandy loam, 0 to 2 percent slopes, used for native hay.

maximum storage of these food reserves is completed by the frost period. Since haying activities generally extend over a period of several weeks, large meadows can be divided into three parts and mowed in rotation. One part should be mowed 2 weeks before the seedstalks appear in the dominant plants, another part at the boot stage, and the last part early in the flowering period. The order in which the three parts are mowed should be changed in successive years. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed before the frost leaves the soil in the spring and before the water table reaches a high level.

This soil is poorly suited to the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand a very high water table. Establishing trees may be difficult in wet years. Special planting methods may be needed to keep the seedlings from drowning. Planting should be delayed until the water table drops and the soil dries out, so that it can be tilled. Weeds and undesirable grasses can be controlled by cultivating when the water table is at its lowest level.

This soil is unsuitable as a site for septic tank absorption fields and dwellings because of the wetness. A suitable alternative site is needed. Sewage lagoons should be constructed on fill material, which can raise the bottom of the lagoon a sufficient distance above the seasonal high water table. Lining or sealing the lagoon helps to prevent seepage. The sides of shallow excavations can cave in unless they are temporarily shored. The excavations should be made during dry periods. Constructing local roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the road damage caused by wetness.

The land capability unit is Vw-7, dryland; Wet Subirrigated range site; windbreak suitability group 2D.

Lr—Loup fine sandy loam, wet, 0 to 2 percent slopes. This deep, nearly level, very poorly drained soil is on valley floors in the sandhills and on bottom land along drainageways. It is subject to rare flooding and is commonly ponded by water from a very high water table. The soil formed in sandy alluvial material. Areas range from 5 to 350 acres in size.

Typically, the surface layer is very dark gray, very friable fine sandy loam about 8 inches thick. The subsurface layer is very dark gray, friable loam about 6 inches thick. The transition layer is gray, very friable loamy sand about 2 inches thick. The underlying material to a depth of more than 60 inches is loose fine sand. The upper part is light gray and has dark brown mottles, and the lower part is white and has reddish brown mottles. In some places the surface layer is loam or sandy clay loam. In other places a thin layer of silty clay loam is in the lower part of the surface layer. In a few places the surface layer is less than 10 inches thick. In some areas near the sandhills, a thin layer of light colored fine sand is at the surface. In some areas coarse sand is below a depth of 20 inches.

Included with this soil in mapping are small areas of Elsmere and Marlake soils. Elsmere soils are in the higher landscape positions and are somewhat poorly drained. Marlake soils are in the lower positions and are wetter than the Loup soil. Also included, at the outer edges of the unit, are areas of alkali soils. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Loup soil, and the available water capacity is low. Organic matter content is high. Runoff is very slow. The seasonal high water table is about 0.5 foot above the surface in wet years and is within a depth of 1.0 foot in dry years. It normally drops to a depth of 1 to 2 feet by late summer.

This soil supports native grasses and is used for range or hay. It is not suitable as cropland because it is too wet. The climax vegetation is dominated by prairie cordgrass, bluejoint reedgrass, northern reedgrass, and various sedges. These species make up 65 percent or more of the total annual production. Bluegrass, slender wheatgrass, green muhly, and forbs make up the rest. Under continuous heavy grazing or improper haying, prairie cordgrass, bluejoint reedgrass, northern reedgrass, and reed canarygrass decrease in abundance. Initially, these species are replaced by slender wheatgrass, plains bluegrass, green muhly, and various sedges, rushes, and forbs. If overgrazing or improper haying continues for many years, bluegrass, foxtail barley, and various sedges, rushes, and forbs dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 1.5 animal unit months per acre. If haying or grazing is delayed until late in the growing season, the quantity of the forage is high but the quality is low. The higher quality forage is available early in the growing season. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous and the quality and quantity of the forage are high. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. In some years hay cannot be harvested because of the excessive wetness. After the soil is frozen, livestock can graze without damaging the

meadows. They should be removed before frost leaves the soil in the spring and the water table reaches a high level.

This soil is unsuited to the trees and shrubs grown as windbreaks because of the wetness. Some areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat and for forestation plantings if suitable species are hand planted or other special management is applied.

This soil is unsuitable as a site for septic tank absorption fields and dwellings because of the ponding. A suitable alternative site is needed. Sewage lagoons should be constructed on fill material, which can raise the bottom of the lagoon a sufficient distance above the seasonal high water table. Lining or sealing the lagoon helps to prevent seepage. The lagoon should be diked because of the ponding. The sides of shallow excavations can cave in unless they are temporarily shored. The excavations should be made during dry periods. Constructing local roads on suitable, well compacted fill material above the level of ponding and providing adequate side ditches and culverts help to prevent the road damage caused by ponding.

The land capability unit is Vw-7, dryland; Wetland range site; windbreak suitability group 10.

Ma—Marlake loamy fine sand, 0 to 2 percent slopes. This deep, nearly level, very poorly drained soil is in depressions or basins on valley floors. It is frequently ponded by water from a very high water table. The soil formed in sandy alluvium or in alluvium overlain by sandy eolian material. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark gray, very friable loamy fine sand about 7 inches thick. The transition layer is about 15 inches of grayish brown, very friable loamy sand that is finely stratified with dark gray loamy fine sand and light brownish gray fine sand and that has yellowish brown mottles. The underlying material to a depth of more than 60 inches is light brownish gray and light gray fine sand stratified with thin layers of loamy sand. It has yellowish brown mottles in the upper part. In places loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Loup and Tryon soils. These soils are slightly higher on the landscape than the Marlake soil and are not so wet. Also included are small lakes in low areas and, at the outer edges of the unit, areas where the soil is severely affected by alkali. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Marlake soil, and the available water capacity is low. Organic matter content is high. Runoff generally is ponded. The seasonal high water table is as much as 2 feet above the surface in wet years and is within a depth of about 1 foot in dry years. Water covers the surface for long periods during most years. During extended dry periods, the water table usually drops below the surface.

Most areas are used for wildlife habitat or for grazing by livestock. In the driest years, some areas in meadows are mowed for mulching material or are cleared of dead plant residue. This soil is too wet for cultivated crops, hay, and range. The vegetation is mainly cattails, rushes, arrowheads, willows, and other water-tolerant plants. It is not palatable to livestock. In some areas V-ditches can be installed to improve surface drainage. Such grasses such as prairie cordgrass and reed canarygrass can then be established. The vegetation can be mowed only during extremely dry years.

This soil is unsuited to the trees and shrubs grown as windbreaks because of the wetness. A few marginal areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat and for forestation plantings if suitable species are hand planted or other special management is applied.

This soil is generally unsuitable as a site for septic tank absorption fields, sewage lagoons, and dwellings because of the ponding. A suitable alternative site is needed. The sides of shallow excavations can cave in unless they are temporarily shored. The excavations should be made only during extremely dry periods. Constructing local roads on suitable, well compacted fill material above the level of ponding and providing adequate side ditches and culverts help to prevent the road damage caused by ponding.

The land capability unit is VIIIw-7, dryland; windbreak suitability group 10. No range site is assigned.

Nb—Nimbro silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on stream terraces. It formed in alluvium. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable, calcareous silt loam about 8 inches thick. The subsurface layer is gray, very friable, calcareous silt loam about 12 inches thick. The underlying material extends to a depth of more than 60 inches. It is mottled and calcareous. The upper part is light brownish gray silt loam, and the lower part is grayish brown loam stratified with brown and pale brown material. In places fine sand or coarse sand is below a depth of 30 inches.

Included with this soil in mapping are small areas of Boelus and Loretto soils. These soils are in high positions on the landscape. Boelus soils have a sandy surface layer. Loretto soils contain more clay in the subsoil than the Nimbro soil. Included soils make up less than 10 percent of the unit.

Permeability is moderate in the Nimbro soil, and the available water capacity is high. Organic matter content is moderate. The water intake also is moderate. Runoff is slow. The soil can be easily worked if good tilth is maintained.

Most of the acreage of this soil is used as cropland. Some areas are irrigated.

If used for dryland farming, this soil is suited to corn, sorghum, small grain, soybeans, alfalfa, and introduced grasses. A scarcity of precipitation is the major problem. Small grain and the first cutting of alfalfa are generally more dependable than other crops because they grow and mature in spring, when the amount of rainfall is highest. No-till planting and stubble mulching conserve moisture. Because they keep crop residue on the surface, they also help to maintain the content of organic matter and improve fertility.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and alfalfa. It is suitable for gravity and sprinkler irrigation. In most areas some land leveling is needed if a gravity system is used. Control of the amount of water applied and the time of application, additions of fertilizer, and a high plant population are needed. Keeping crop residue on the surface prevents excessive loss of soil moisture.

This soil is suited to introduced pasture grasses, such as smooth brome, orchardgrass, and tall fescue. A cover of these grasses is effective in controlling soil blowing. Pasture can be included in a cropping sequence with row crops. Overgrazing depletes the protective plant cover and causes deterioration of the desirable grasses. Proper stocking rates and rotation grazing help to keep the pasture in good condition. Applications of nitrogen fertilizer and irrigation water can increase forage production.

This soil is well suited to the trees and shrubs grown as farmstead, feedlot, and field windbreaks and as plantings that enhance recreational areas or wildlife habitat. It receives runoff from the adjacent soils. The additional moisture is beneficial. Competition for moisture from weeds and shrubs is the main concern in establishing trees. It can be controlled by timely cultivation between the tree rows and by applications of carefully selected herbicide when the site is prepared for planting. Supplemental water is needed during droughty periods.

The moderate permeability of this soil is a limitation on sites for septic tank absorption fields, but it can generally be overcome by increasing the size of the absorption field. Lining or sealing sewage lagoons helps to prevent seepage. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the structural damage caused by shrinking and swelling of the soil. Local roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

The land capability units are IIc-1, dryland, and I, irrigated; Silty Lowland range site; windbreak suitability group 1L.

Or—Ord loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom land. It is subject to rare flooding. It formed in stratified alluvium. Areas range from 10 to more than 100 acres in size.

Typically, the surface layer is dark gray, calcareous, very friable loam about 6 inches thick. The subsurface layer is gray, calcareous, very friable loam about 8 inches thick. The transition layer is light brownish gray, very friable fine sandy loam about 12 inches thick. The underlying material to a depth of more than 60 inches is light gray fine sand. It has reddish brown mottles and thin strata of loamy fine sand. In some places the surface layer is fine sandy loam or sandy clay loam. In other places it is noncalcareous. In a few areas the underlying material is coarse sand below a depth of 30 inches. In a few places layers of loamy material are below a depth of 20 inches.

Included with this soil in mapping are small areas of Elsmere, Ipage, and Loup soils. Elsmere soils are in landscape positions similar to those of the Ord soil. They contain more sand than the Ord soil. Ipage soils are in the higher landscape positions and are moderately well drained. Loup soils are in the lower positions and are poorly drained or very poorly drained. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Ord soil and rapid in the lower part. The available water capacity and organic matter content are moderate. The water intake rate is moderately high. Runoff is slow. Reaction is neutral to moderately alkaline. The depth to the seasonal high water table ranges from 1.5 feet in wet years to 3.5 feet in dry years.

Most of the acreage of this soil is cropland. The rest supports native grasses and is used as range or hayland.

If used for dryland farming, this soil is suited to corn, sorghum, soybeans, alfalfa, small grain, and introduced grasses. It is less well suited to spring-sown small grain than to other crops because the water table is usually highest in the spring and the wetness delays seedbed preparation. The water table may drown out alfalfa in some low spots, but growing alfalfa and winter wheat eliminates the need for tillage in the spring. Drainage ditches or tile drains can lower the water table. Returning crop residue to the soil helps to maintain the organic matter content. Adding barnyard manure helps to maintain or improve fertility.

If irrigated, this soil is suited to corn, sorghum, soybeans, alfalfa, and introduced grasses. It is well suited to sprinkler irrigation. Land leveling is generally needed if furrow or border irrigation methods are used. The soil dries out slowly in spring. As a result, tillage may be delayed. Tile generally is not needed in irrigated areas, but the water table can be a problem in wet periods. If suitable outlets are available, drainage ditches or tile drains can lower the water table. Leaving crop

residue on the surface throughout the winter helps to control soil blowing.

If this soil is used for range, the climax vegetation is dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges and rushes. These species make up 80 percent or more of the total annual production. Plains bluegrass, slender wheatgrass, western wheatgrass, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, little bluestem, switchgrass, indiangrass, and prairie cordgrass decrease in abundance. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, foxtail barley, slender wheatgrass, green muhly, and various sedges and rushes. Timothy, redtop, and clover also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, clover, and other forbs, such as Baldwin ironweed, dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 1.7 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities. The areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with better drained soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the maximum storage of these food reserves is completed by the frost period. The quality of the hay is higher when the grasses are cut earlier. After the soil is frozen, livestock can graze without damaging the meadows. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to some of the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand a moderately high water table. Establishing seedlings can be difficult during wet years. The site should be tilled and the seedlings planted after the soil dries out. The abundant and persistent herbaceous vegetation on this soil competes with the trees and shrubs. It can be controlled by cultivation between the tree rows with conventional tillage equipment and by timely applications of herbicide. The areas near the trees can be rototilled or hoed by hand.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Fill material can elevate absorption fields and the bottom of sewage lagoons a sufficient distance above the seasonal high water table. Lining or sealing the lagoons helps to prevent seepage.

The sides of shallow excavations in this soil can cave in unless they are temporarily shored. The excavations should be made during dry periods. Dwellings should be constructed on raised, well compacted fill material, which helps to overcome the wetness caused by the seasonal high water table and by flooding. The damage to local roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIw-4, dryland, and IIw-8, irrigated; Subirrigated range site; windbreak suitability group 2S.

Tn—Tryon loamy fine sand, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is in valleys in the sandhills. It is subject to rare flooding. It formed in wind- and water-deposited sandy material. Areas range from 5 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 7 inches thick. The transition layer is grayish brown, very friable loamy sand about 5 inches thick. It has reddish brown mottles. The underlying material to a depth of more than 60 inches is light brownish gray and light gray, loose fine sand. It has yellowish brown mottles. In a few places the surface layer is fine sandy loam. In areas adjacent to large areas of the sandhills, a thin layer of fine sand is common at the surface. In some areas the soil is dark to a depth of more than 10 inches.

Included with this soil in mapping are small areas of Els and Marlake soils. Els soils are in the slightly higher landscape positions and are somewhat poorly drained. Marlake soils are in the lower positions and are subject to ponding. Also included are some areas where the soil is severely affected by alkali. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Tryon soil, and the available water capacity is low. Organic matter content is high. Runoff is very slow. The seasonal high water table

is near the surface in wet years and is within a depth of about 1.5 feet in dry years. Water may cover the surface for a few days in the spring and during periods of above normal rainfall. The water table usually drops to a depth of about 2 to 3 feet in late summer.

Most of the acreage is range that is either grazed or used for hay. This soil is too wet to be used as cropland. The climax vegetation is dominated by switchgrass, indiangrass, big bluestem, prairie cordgrass, and various sedges and rushes. These species make up 75 percent or more of the total annual production. Bluegrass slender wheatgrass, Canada wildrye, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, bluejoint reedgrass, northern reedgrass, prairie cordgrass, switchgrass, indiangrass, and reed canarygrass decrease in abundance. Initially, these species are replaced by slender wheatgrass, western wheatgrass, plains muhly, and various sedges. Timothy, redtop, and clover also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, western wheatgrass, foxtail barley, and various sedges, rushes, and forbs dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 1.9 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities. The areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with better drained, sandy soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the maximum storage of these food reserves is completed by the frost period. Since haying activities generally extend over a period of several weeks, large meadows can be divided into three parts and mowed in rotation. One part should be mowed 2 weeks before seedstalks appear in the dominant plants, another part at the boot stage, and the last part early in the flowering period. The order in which the three parts are mowed should be changed in successive years. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed before frost leaves the soil in the spring and the water table reaches a high level.

This soil is poorly suited to the trees and shrubs grown as windbreaks. The seasonal high water table is the main limitation. The only suitable species are those that can withstand the wetness. Site preparation and planting may not be possible until the water table drops and the soil is sufficiently dry. The weeds and undesirable grasses that compete with the trees and shrubs can be controlled by cultivating between the tree rows when the water table is at its lowest level. The areas close to the trees can be rototilled or hoed by hand.

This soil is unsuitable as a site for septic tank absorption fields and dwellings because of the wetness. A suitable alternative site is needed. Sewage lagoons should be constructed on fill material, which can raise the bottom of the lagoon a sufficient distance above the seasonal high water table. Lining or sealing the lagoon helps to prevent seepage. The sides of shallow excavations can cave in unless they are temporarily shored. The excavations should be made during dry periods. Constructing local roads and streets on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the road damage caused by wetness.

The land capability unit is Vw-7, dryland; Wet Subirrigated range site; windbreak suitability group 2D.

Tp—Tryon loamy fine sand, wet, 0 to 2 percent slopes. This deep, nearly level, very poorly drained soil is on valley floors in the sandhills and on bottom land along some of the major streams that drain the sandhills. The soil is commonly ponded by water from a very high water table in the spring and during other wet periods. It is subject to rare flooding. It formed in wind- and water-deposited sandy material. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark gray, very friable loamy fine sand about 5 inches thick. The transition layer is grayish brown, loose loamy sand about 4 inches thick. The underlying material to a depth of more than 60 inches is fine sand. It is light brownish gray and calcareous in the upper part and light gray in the lower part. It has distinct, brown mottles. A stratum of grayish brown fine sand is at a depth of 18 to 24 inches. In places the surface layer is fine sand or fine sandy loam. In some areas the soil is dark to a depth of more than 10 inches.

Included with this soil in mapping are small areas of Els and Marlake soils. Els soils are in the slightly higher landscape positions and are somewhat poorly drained. Marlake soils are lower on the landscape than the Tryon soil and are wet for longer periods. Also included, at the

outer edge of many areas, is a narrow band where the soil is alkali. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Tryon soil, and the available water capacity is low. Organic matter content is high. Runoff is very slow. The seasonal high water table is about 0.5 foot above the surface in wet years and is within a depth of about 1.0 foot in dry years. It usually drops to a depth of about 1 to 2 feet by late summer.

Most of the acreage is range that is grazed or used for hay. This soil is too wet for cultivation. The climax vegetation is dominated by prairie cordgrass, bluejoint reedgrass, northern reedgrass, and various sedges. These species make up 65 percent or more of the total annual production. Bluegrass, slender wheatgrass, green muhly, and forbs make up the rest. Under continuous heavy grazing or improper haying, prairie cordgrass, bluejoint reedgrass, northern reedgrass, and reed canarygrass decrease in abundance. Initially, these species are replaced by slender wheatgrass, plains bluegrass, green muhly, and various sedges, rushes, and forbs. If overgrazing or improper haying continues for many years, bluegrass, foxtail barley, and various sedges, rushes, and forbs dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 1.5 animal unit months per acre. If haying or grazing is delayed until late in the growing season, the quantity of the forage is high but the quality is low. The higher quality forage is available early in the growing season. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, restricted use during very wet periods helps to maintain or improve the range condition.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous and the quality and quantity of forage are high. Mowing should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed before frost leaves the soil in the spring and the water table reaches a high level. In some years hay cannot be harvested because of excessive wetness.

This soil is unsuited to the trees and shrubs grown as windbreaks because of the wetness caused by the seasonal high water table. A few areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat and for forestation plantings if suitable species are hand planted or other special management is applied.

This soil is unsuitable as a site for septic tank absorption fields and dwellings because of the ponding. A suitable alternative site is needed. Sewage lagoons should be constructed on fill material, which can raise the bottom of the lagoon a sufficient distance above the seasonal high water table. Lining or sealing the lagoon helps to prevent seepage. The lagoon should be diked because of the ponding and flooding. The sides of shallow excavations can cave in unless they are temporarily shored. The excavations should be made during dry periods. Constructing local roads and streets on suitable, well compacted fill material above the level of ponding and providing adequate side ditches and culverts help to prevent the road damage caused by ponding.

The land capability unit is Vw-7, dryland; Wetland range site; windbreak suitability group 10.

Ts—Tryon-Inavale complex, channeled. These deep, nearly level soils are on flood plains dissected by meandering stream channels. The poorly drained Tryon soil is in the lower areas. It is frequently flooded for short periods. The somewhat excessively drained Inavale soil is in the higher areas. It is subject to rare flooding. Both soils formed in alluvium. Slopes range from 0 to 2 percent. Areas range from 15 to several hundred acres in size. They occur as long and narrow, irregular tracts that may border stream channels for miles. The areas are about 40 to 65 percent Tryon soil and 20 to 40 percent Inavale soil. The two soils occur as areas so intricately mixed that separating them in mapping is not practical.

Typically, the Tryon soil has a surface layer of very dark gray, very friable loamy fine sand about 5 inches thick. The transition layer is grayish brown, very friable loamy sand about 4 inches thick. The upper part of the underlying material is light brownish gray, mottled fine sand. The lower part to a depth of more than 60 inches is light gray, mottled fine sand and sand. In a few places the underlying material is stratified with coarse sand. In some areas the soil is dark to a depth of more than 10 inches.

Typically, the Inavale soil has a surface layer of grayish brown, very friable loamy sand about 6 inches thick. The transition layer is about 8 inches of grayish brown, very friable loamy sand stratified with thin layers of darker loamy material. The underlying material to a depth of more than 60 inches is fine sand. It is light brownish gray in the upper part and very pale brown in the lower part. It has mottles below a depth of 40 inches.

Included with these soils in mapping are small areas of Els soils and the sandy Fluvaquents. Els soils are somewhat poorly drained and are in areas between the Tryon and Inavale soils. Fluvaquents are very poorly drained and are in the lower landscape positions. Included soils make up about 15 percent of the unit.

Permeability is rapid in the Tryon and Inavale soils, and the available water capacity is low. The water intake rate is very high. Organic matter content is high in the Tryon soil and low in the Inavale soil. Runoff is very slow on the Tryon soil and slow on the Inavale soil. The Tryon soil has a seasonal high water table that is near the surface in wet years and within a depth of 1.5 feet in dry years. During dry periods the water table can drop to a depth of 5 to 6 feet. The level of the water in the nearby stream channels affects the depth to the water table.

All of the acreage is range. It is used mainly for grazing, but a few small areas adjacent to meadows are used for hay. The Tryon soil is too wet for cultivated crops. The Inavale soil is not suitable as cropland or hayland because it is cut into small tracts by the meandering streams. The tracts are too small to farm and are difficult to mow. Cottonwood and willow trees are common along the streams.

These soils are suited to range. The natural plant community on the Tryon soil is dominated by switchgrass, indiangrass, big bluestem, prairie cordgrass, and various sedges and rushes. These species make up 75 percent or more of the total annual production on this soil. Plains bluegrass, slender wheatgrass, Canada wildrye, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, prairie cordgrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by slender wheatgrass, western wheatgrass, plains muhly, and various sedges. If overgrazing continues for many years, bluegrass, western wheatgrass, foxtail barley, sedges, rushes, and forbs dominate the site.

The natural plant community on the Inavale soil is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. These species make up 75 percent or more of the total annual production on this soil. Blue grama, Kentucky bluegrass, prairie junegrass, sand dropseed, indiangrass, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance. Initially, these plants are replaced by prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggest initial stocking rate is 1.9 animal unit months per acre on the Tryon soil and 1.0 animal unit month per acre on the Inavale soil. A planned grazing system that includes proper grazing use, timely deferment of grazing, and restricted use during very wet periods helps to maintain or improve the range condition. Because these soils are generally adjacent to streams, salting facilities should be located in other areas of the range. Overgrazing is likely if the facilities are located in areas of these soils.

Because they are dissected by channels and oxbows, these soils generally are not used for hay. Boggy conditions develop in pastured areas when the water table is at the surface of the Tryon soil. Floods can deposit trash and debris and can damage fences.

These soils are unsuited to the trees and shrubs grown as windbreaks because of the wetness and the flooding. Some areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat if suitable species are hand planted and other special management is applied.

These soils are generally unsuitable as sites for septic tank absorption fields, sewage lagoons, and dwellings because of the flooding. A suitable alternative site is needed. The sides of shallow excavations can cave in unless they are temporarily shored. Constructing local roads on suitable, well compacted fill material above the level of flooding and providing adequate side ditches and culverts help to prevent the road damage caused by flooding and wetness.

The land capability unit is VIw-7, dryland; windbreak suitability group 10. The Tryon soil is in the Wet Subirrigated range site, and the Inavale soil is in the Sandy Lowland range site.

UbC—Uly silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on ridgetops and side slopes in the uplands. It formed in loess. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 5 inches thick. The subsurface layer also is dark grayish brown, very friable silt loam. It is about 6 inches thick. The subsoil is silt loam about 21 inches thick. It is dark grayish brown and friable in the upper part, brown and firm in the next part, and pale brown and friable in the lower part. The underlying material to a depth of more than 60 inches is very pale brown, calcareous silt loam. In a few places the soil is dark to a depth of less than 7 inches.

Included with this soil in mapping are small areas of Hall and Coly soils. Hall soils are on the lower side slopes. They have more clay in the subsoil than the Uly soil. Coly soils are on narrow ridgetops. They are shallower to lime than the Uly soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Uly soil, and the available water capacity is high. Organic matter content is moderately low. The water intake rate is moderate. Runoff is medium.

Most of the acreage is used for dryland or irrigated crops. If used for dryland farming, this soil is suited to corn, grain sorghum, wheat, and alfalfa. Water erosion is a hazard unless the surface is protected by vegetation or crop residue. Terraces, contour farming, and conservation tillage help to prevent excessive erosion and conserve

moisture. Returning crop residue and green manure crops to the soil helps to maintain or increase the organic matter content and improves fertility.

If irrigated by sprinklers, this soil is suited to corn, grain sorghum, and alfalfa. It is not suitable for gravity irrigation unless the slope can be reduced by land leveling. Water erosion can be controlled by terraces, contour farming, conservation tillage, and close-grown crops, such as alfalfa and grasses for hay or pasture. Efficient water management and measures that control runoff are needed. Returning crop residue to the soil helps to maintain or increase the organic matter content and improves fertility.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by big bluestem, blue grama, little bluestem, sideoats grama, and western wheatgrass. These species make up 70 percent or more of the total annual production. Switchgrass, buffalograss, needleandthread, prairie junegrass, Scribner panicum, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance. Initially, these species are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. Under these conditions, excessive water erosion and soil blowing occur.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may by underused. Properly located fences, livestock water (fig. 12), and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to native grasses if a proper seedbed is prepared, a suitable cover crop is grown for 2 or more years, and a suitable seed mixture is selected for planting.

If this soil is used as hayland, the forage should be harvested only ever other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. Water erosion and a scarcity of moisture are the main concerns in establishing seedlings. Planting on the contour or terracing helps to control erosion. Maintaining strips of sod or a cover crop between the tree rows also helps to control erosion. Supplemental water is needed during dry periods. Undesirable grasses and weeds compete with the trees and shrubs for moisture. They can be controlled by cultivating between the tree rows or by applying appropriate herbicide.

This soil is suitable as a site for septic tank absorption fields and dwellings. Seepage is a hazard on sites for sewage lagoons. It can be controlled by lining or sealing the lagoon. Grading is needed to modify the slope and shape the lagoon. Local roads should be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil.

The land capability units are IIIe-1, dryland, and IIIe-6, irrigated; Silty range site; windbreak suitability group 3.

UbD2—Uly silt loam, 6 to 11 percent slopes, eroded. This deep, strongly sloping, well drained soil is on side slopes and ridgetops in the uplands. It formed in loess. Some or all of the original surface layer has been removed by erosion. In places the present surface layer has been mixed with the subsoil by plowing. Areas range from 10 to 200 acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 7 inches thick. The subsoil is silt loam about 20 inches thick. The upper part is grayish brown and very friable, the next part is grayish brown and friable, and the lower part is brown, friable, and calcareous. The underlying material to a depth of more than 60 inches is pale brown, calcareous silt loam. In some areas the surface layer is lighter colored. In a few places the subsoil is silty clay loam.

Included with this soil in mapping are small areas of Coly and Hall soils. Coly soils are calcareous near the surface. They generally are on the steeper slopes. Hall soils have more clay in the subsoil than the Uly soil. They are on the smoother, more nearly level slopes. Included soils make up 10 to 15 percent of the unit.

Figure 12.—Livestock water in an area of Uly silt loam, 3 to 6 percent slopes.

Permeability is moderate in the Uly soil, and the available water capacity is high. Organic matter content is low. The water intake rate is moderate. Runoff is medium.

Most of the acreage of this soil is farmed. Some areas have been reseeded to native or introduced grasses and are used as range or hayland.

If used for dryland farming, this soil is poorly suited to corn, sorghum, wheat, and alfalfa. Water erosion is the principal hazard. Terraces, contour farming, stubble mulching, and a system of conservation tillage that leaves crop residue on the surface help to control erosion. Returning crop residue to the soil and applying barnyard manure increase the organic matter content and the available water capacity and improve fertility.

If irrigated, this soil is poorly suited to alfalfa, sorghum, introduced grasses, and corn. A sprinkler system is the best method of irrigation. Terraces, contour farming, and a system of conservation tillage that leaves crop residue on the surface help to control water erosion. A cropping sequence that is dominated by close-grown crops, such as alfalfa and grasses, helps to protect the surface. Returning crop residue to the soil increases the organic matter content and improves fertility. If a center-pivot irrigation system is used, erosion can occur in the wheel tracks and small gullies can form. Adjusting the application rate to the water intake rate of the soil helps to prevent excessive runoff.

This soil is suited to introduced or domestic grasses for pasture or hay. Pasture and hay can be alternated with other crops in the crop rotation. Cool-season grasses, such as smooth brome and orchardgrass, are suitable, either alone or in a mixture with legumes, such as alfalfa or trefoil. Warm-season grasses also can be grown. Separate pastures of warm- and cool-season grasses can provide a long season of grazing. Introduced grasses respond well to applications of fertilizer and to irrigation.

If this soil is used for range, the climax vegetation is dominated by big bluestem, blue grama, little bluestem, sideoats grama, and western wheatgrass. These species make up 70 percent or more of the total annual production. Switchgrass, buffalograss, needleandthread, prairie junegrass, Scribner panicum, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance. Initially, these species are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. Under these conditions, excessive water erosion and soil blowing occur.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to native grasses if a proper seedbed is prepared, a cover crop grown for 2 or more years, and a suitable seed mixture is selected for planting.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. Water erosion, droughtiness, and plant competition are the principal management concerns. Planting on the contour and terracing help to control erosion. Cultivating between the tree rows helps to control weeds and undesirable grasses. Irrigation is needed during periods of low rainfall.

The slope is a limitation if this soil is used as a site for sanitary facilities or dwellings. Septic tank absorption fields should be installed on the contour. Land shaping is needed on sites for septic tank absorption fields and sewage lagoons. Lining or sealing the lagoons helps to prevent seepage. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to an acceptable gradient. Local roads should be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil. Providing coarser grained subgrade or base material helps to ensure better performance.

The land capability units are IVe-8, dryland, and IVe-6, irrigated; Silty range site; windbreak suitability group 3.

VaB—Valentine fine sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, excessively drained soil is in enclosed valleys within the sandhills and in transitional areas adjacent to the sandhills. It is mainly on low, hummocky topography. It formed in sandy windblown material. Areas range from 5 to more than 200 acres in size.

Typically, the surface layer is grayish brown, very friable fine sand about 5 inches thick. The transition layer is grayish brown, loose fine sand about 4 inches thick. The underlying material to a depth of more than 60 inches is pale brown fine sand. In places loamy material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Els, Ipage, Marlake, and Tryon soils. Els, Marlake, and Tryon soils are in valleys and swales. They have a seasonal high water table. Ipage soils are in the slightly lower landscape positions and are moderately well drained. Also included are a few small areas of Blownout land. Included areas make up less than 15 percent of the unit.

Permeability is rapid in the Valentine soil, and the available water capacity is low. Organic matter content also is low. The water intake rate is very high. Runoff is slow.

Most of the acreage supports native grasses and is used as range or hayland. A few areas are used for irrigated crops. Because of droughtiness and the hazard of soil blowing, this soil is unsuited to dryland crops. If irrigated, it is poorly suited to corn, alfalfa, and introduced grasses. It is unsuitable for gravity methods of irrigation but can be irrigated by sprinklers. Water should be applied frequently and in small amounts. One large application can result in excessive leaching of plant nutrients. Unless the surface is protected by crops or crop residue, soil blowing is a hazard. It can be controlled by planting close-growing crops, leaving crop residue on the surface, and growing winter cover crops. Adding barnyard manure helps to maintain fertility and increases the organic matter content. Grazing of crop residue should be restricted because a maximum cover of residue is needed.

If this soil is used for range, the climax vegetation is dominated by prairie sandreed, sand bluestem, little

bluestem, needleandthread, and blue grama. These species make up 70 percent or more of the total annual production. Sand dropseed, indiangrass, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, bluegrass, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with Sands or Choppy Sands range sites. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland can be reseeded to a suitable grass mixture if a proper seedbed is prepared and a suitable cover crop grown for 2 or more years.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. It is so loose, however, that seedlings should be planted in shallow furrows with as little disturbance of the surface as possible. Young seedlings can be damaged by windblown sand. Weeds and undesirable grasses near the trees can be controlled by timely applications of herbicide or by cultivation.

This soil is suitable as a site for dwellings and local roads. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of nearby water supplies. Lining or sealing sewage lagoons helps to prevent seepage. The sides of shallow excavations can cave in unless they are temporarily shored.

The land capability units are VIe-5, dryland, and IVe-12, irrigated; Sandy range site; windbreak suitability group 7.

VaD—Valentine fine sand, 3 to 9 percent slopes. This deep, gently sloping and strongly sloping, excessively drained soil is on hummocky dunes in the uplands. It formed in sandy windblown material. Areas range from 5 to 600 acres in size.

Typically, the surface layer is grayish brown, very friable fine sand about 6 inches thick. The transition layer is pale brown, loose fine sand about 4 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand. In a few places loamy buried layers are at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Els, Ipage, Marlake, and Tryon soils. These soils are in the lower positions on the landscape. Els soils are somewhat poorly drained, Ipage soils are moderately well drained, Marlake soils are very poorly drained, and Tryon soils are poorly drained or very poorly drained. Also included are some small blowouts. Included areas make up 10 to 15 percent of the unit.

Permeability is rapid in the Valentine soil, and the available water capacity is low. Organic matter content also is low. The water intake rate is very high. Runoff is slow.

Most of the acreage supports native grasses and is used as range. A few areas are cultivated. They are irrigated by sprinkler systems. Because of droughtiness and the hazard of soil blowing, this soil is unsuited to dryland crops. If irrigated, it is poorly suited to corn, alfalfa, small grain, and introduced grasses. It is not suitable for gravity methods of irrigation but can be irrigated by sprinklers. Frequent, light water applications are needed. One large application can result in excessive leaching of plant nutrients. Unless the surface is protected by crops or crop residue, soil blowing is a hazard. It can be controlled by planting close-growing crops, leaving crop residue on the surface, and growing winter cover crops. Grazing of crop residue should be restricted because a maximum cover of residue is needed. Adding barnyard manure helps to maintain fertility and the organic matter content.

If this soil is used for range, the climax vegetation is dominated by sand bluestem, prairie sandreed, sand lovegrass, switchgrass, little bluestem, and needleandthread (fig. 13). These species make up 75 percent or more of the total annual production. Blue grama, indiangrass, sand dropseed, porcupinegrass, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass,

switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, sandhill muhly, annual grasses, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. Under these conditions, excessive soil blowing occurs and blowouts form.

If the range is in excellent condition, the suggested initial stocking rate is 0.8 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse the gentle slopes and the areas near watering facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable native grass mixture. Blowouts can be stabilized in a few years by a planned grazing system. Steep banks should be sloped to a stable grade before they are revegetated. If fences are used to exclude livestock, shaping, seeding, and mulching the blowouts can hasten the reclamation process.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during

Figure 13.—Native grasses in an area of Valentine fine sand, 3 to 9 percent slopes, where the range is in excellent condition.

the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. It is so loose, however, that seedlings should be planted in shallow furrows with as little disturbance of the surface as possible. Young seedlings can be damaged by windblown sand. Maintaining strips of sod or other vegetation between the tree rows reduces the susceptibility to soil blowing. Weeds and undesirable grasses compete with the trees and shrubs for moisture. The weeds in areas near the trees can be controlled by applications of appropriate herbicide or by hand hoeing.

This soil is suitable as a site for dwellings and local roads. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of nearby water supplies. Lining or sealing sewage lagoons helps to prevent seepage. The sides of shallow excavations can cave in unless they are temporarily shored.

The land capability units are VIe-5, dryland, and IVe-12, irrigated; Sands range site; windbreak suitability group 7.

VaE—Valentine fine sand, rolling. This deep, excessively drained soil is on hummocky dunes in the sandhills. It formed in sandy windblown material. Slopes range from 9 to 24 percent. Areas range from 10 to 2,000 acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 5 inches thick. The transition layer is pale brown, loose fine sand about 7 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand. In places the surface layer is loamy sand or loamy fine sand.

Included with this soil in mapping are small areas of Els, Ipage, and Tryon soils. Els and Tryon soils are in swales and have a seasonal high water table. Ipage soils are in the lower landscape positions and are moderately well drained. Also included are small blowouts and some small areas where the slope is less than 9 or more than 24 percent. Included areas make up 10 to 15 percent of the unit.

Permeability is rapid in the Valentine soil, and the available water capacity is low. Organic matter content also is low. Runoff is slow.

Most areas support native grasses and are used as range. A few areas are used for hay. Some areas, generally those near less sloping soils, are used for dryland or irrigated crops. This soil is unsuitable as cropland because of the slope and the hazards of soil blowing and water erosion.

This soil is suited to range. The climax vegetation is dominated by sand bluestem, prairie sandreed, little bluestem, sand lovegrass, and needleandthread. These species make up 75 percent or more of the total annual production. Blue grama, hairy grama, indiangrass, sand dropseed, switchgrass, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, hairy grama, blue grama, sedges, sandhill muhly, annual grasses, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. Under these conditions, excessive soil blowing occurs and blowouts form.

If the range is in excellent condition, the suggested initial stocking rate is 0.8 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse the gentler slopes and the areas near watering facilities, roads, and trials. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable native grass mixture. Blowouts can be stabilized in a few years by a planned grazing system. Steep banks should be sloped to a stable grade before they are revegetated. If fences are used to exclude livestock, shaping, seeding, and mulching the blowouts can hasten the reclamation process.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is suited to the trees and shrubs grown as windbreaks. It is so loose, however, that seedlings should be planted in shallow furrows with as little disturbance of the surface as possible. Young seedlings can be damaged by windblown sand. Maintaining strips

of sod or other vegetation between the tree rows helps to control soil blowing. Weeds and undesirable grasses can be hoed by hand.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Lining or sealing sewage lagoons helps to prevent seepage. Grading is needed to modify the slope and shape the lagoon. The sides of shallow excavations can cave in unless they are temporarily shored. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to an acceptable gradient. Cutting and filling are generally needed to establish a suitable grade for local roads and streets.

The land capability unit is VIe-5, dryland; Sands range site; windbreak suitability group 7.

VaF—Valentine fine sand, rolling and hilly. This deep, excessively drained soil formed in sandy windblown material on uplands where rolling and hilly areas are closely intermingled. The hilly part is commonly higher lying than the rolling part. It commonly has irregular catsteps on side slopes. Each part makes up 30 to 70 percent of the mapped areas. Slopes range from 17 to 45 percent. Areas range from 40 to several thousand acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 3 inches thick. The transition layer is pale brown, loose fine sand about 6 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand.

Included with this soil in mapping are areas where the slope is less than 17 percent. These areas are as much as 40 acres in size. Also included are a few blowouts. Included areas make up less than 15 percent of the unit.

Permeability is rapid in the Valentine soil, and the available water capacity is low. Organic matter content also is low. Runoff is slow.

This soil supports native grasses. It is suited to range. The climax vegetation in the rolling areas is dominated by sand bluestem, prairie sandreed, little bluestem, and needleandthread. These species make up 75 percent or more of the total annual production in these areas. Blue grama, hairy grama, indiangrass, sand dropseed, switchgrass, sand lovegrass, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, hairy grama, sedges, sandhill muhly, annual grasses, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. Under these conditions, excessive soil blowing occurs and blowouts form.

The climax vegetation in the hilly areas is dominated by little bluestem, sand bluestem, sand lovegrass, prairie sandreed, and needleandthread. These species make up 65 percent or more of the total annual production in these areas. Hairy grama, indiangrass, sand dropseed, switchgrass, sedges, sandhill muhly, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, hairy grama, sedges, sandhill muhly, annual grasses, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. Under these conditions, excessive soil blowing occurs and blowouts form.

If the range is in excellent condition, the suggested initial stocking rate is 0.8 animal unit month per acre in the rolling areas and 0.6 animal unit month per acre in the hilly areas. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Livestock tend to overuse areas near watering facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. The slope hinders the movement of livestock from one area to another. If the range is used only as summer pasture, small soapweed increases in abundance. It can be controlled by using the pasture as winter range. Blowouts can be stabilized in a few years by a planned grazing system. Steep banks should be sloped to a stable grade before they are revegetated. If fences are used to exclude livestock, shaping, seeding, and mulching the blowouts can hasten the reclamation process.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. Some areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat if suitable species are hand planted or other special management is applied.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Land shaping and installing the distribution lines on the contour help to ensure that the absorption field functions properly. On sites for sewage lagoons, extensive grading is needed to modify the slope and shape the lagoon. Lining or sealing the lagoon helps to prevent seepage.

The sides of shallow excavations in this soil can cave in unless they are temporarily shored. Excavating is difficult because of the slope. Because of the erosion hazard, trenches should be dug across the slope. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to an acceptable gradient. Cutting and filling are generally needed to establish a suitable grade for local roads and streets.

The land capability unit is VIIe-5, dryland; Sands and Choppy Sands range sites; windbreak suitability group 10.

VeB—Valentine loamy fine sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, excessively drained soil is on uplands. It formed in sandy windblown material. Areas range from 5 to 125 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 9 inches thick. The transition layer is grayish brown, very friable loamy fine sand about 8 inches thick. The underlying material to a depth of 60 inches or more is pale brown and very pale brown fine sand. In places the surface layer is sand or fine sand.

Included with this soil in mapping are small areas of Boelus, Dunday, Ipage, and Libory soils. These soils are in positions on the landscape similar to those of the Valentine soil. The well drained Boelus soils have loamy and silty underlying material. Dunday soils are dark to a depth of more than 10 inches. Ipage soils are moderately well drained. Libory soils are moderately well drained and have loamy underlying material. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Valentine soil, and the available water capacity is low. Organic matter content also is low. The water intake rate is very high. Runoff is slow. Tilth is good. The soil can be easily tilled throughout a wide range in moisture content.

Most of the acreage of this soil is used for cultivated crops. The rest supports native grasses and is used as range or hayland. Much of the cropland is irrigated by sprinkler systems.

If used for dryland farming, this soil is poorly suited to corn, small grain, soybeans, and alfalfa. Small grain and alfalfa are generally more dependable than other crops because they grow and mature in spring and early summer, when the amount of rainfall is highest. Unless the surface is protected by crops or crop residue, soil blowing is a hazard. A cropping system that maintains a cover of crops, grasses, or crop residue helps to control soil blowing, conserves moisture, increases the organic matter content, and improves fertility. A cropping sequence that is dominated by close-growing crops helps to control soil blowing and conserves moisture. Stripcropping and conservation tillage also help to control soil blowing. Returning crop residue to the soil increases the organic matter content and improves fertility.

If irrigated, this soil is suited to corn, soybeans, and alfalfa. A sprinkler system is the only suitable method of irrigation. The soil is too sandy for gravity irrigation. The principal hazard is soil blowing. Low fertility and proper distribution of water are management concerns. A system of conservation tillage that keeps a large amount of crop residue on the surface, stripcropping, field windbreaks, and winter cover crops help to control soil blowing. Returning crop residue to the soil increases the organic matter content and improves fertility. Frequent applications of water are needed because of the low available water capacity. One large application can result in excessive water loss and the leaching of plant nutrients below the root zone.

If this soil is used for range, the climax vegetation is dominated by little bluestem, sand bluestem, prairie sandreed, needleandthread, and blue grama. These species make up 70 percent or more of the total annual production. Sand dropseed, indiangrass, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, annual grasses, and forbs. If overgrazing continues for many years, bluegrass, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The steeper slopes and the areas away from the watering facilities may be underused. This is generally the first soil to be overgrazed when it is grazed in conjunction with Sands or Choppy Sands range sites. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable grass mixture.

If this soil is used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during

the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

This soil is well suited to the trees and shrubs grown as windbreaks. The hazard of soil blowing, a scarcity of moisture, and competition for moisture from weeds and grasses are the main concerns in establishing and managing the trees and shrubs. Tillage or applications of chemicals are effective in preparing a favorable site for planting and in conserving moisture. Supplemental water is needed during periods of insufficient rainfall. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Weeds and undesirable grasses in the rows can be controlled by appropriate herbicides or by hand hoeing.

This soil is suitable as a site for dwellings and local roads. It readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Lining or sealing sewage lagoons helps to prevent seepage. The sides of shallow excavations can cave in unless they are temporarily shored. Because of the hazard of soil blowing, areas where the surface is disturbed during construction should be mulched and revegetated with suitable species.

The land capability units are IVe-5, dryland, and IVe-11, irrigated; Sandy range site; windbreak suitability group 5.

VfD—Valentine-Dunday loamy fine sands, 3 to 9 percent slopes. These deep, gently sloping and strongly sloping soils are on uplands. The excessively drained Valentine soil is mainly on the convex upper side slopes and ridgetops or in areas where erosion has thinned the surface layer. The well drained Dunday soil is generally on the concave lower side slopes and in swales. Both soils formed in sandy windblown material. Areas range from 5 to 300 acres in size. They are 60 to 70 percent Valentine soil and 20 to 30 percent Dunday soil. The two soils occur as areas so intricately mixed that separating them in mapping is not practical.

Typically, the Valentine soil has a surface layer of dark grayish brown, very friable loamy fine sand about 7 inches thick. The transition layer is pale brown, loose fine sand about 7 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand. In some places the surface layer is sand or fine sand. In other places loamy material is at a depth of 40 to 60 inches.

Typically, the Dunday soil has a surface layer of dark grayish brown, very friable loamy fine sand about 9 inches thick. The subsurface layer also is dark grayish brown, very friable loamy fine sand. It is about 4 inches thick. The transition layer is brown, very friable loamy fine sand about 13 inches thick. The underlying material to a depth of more than 60 inches is pale brown fine sand. In places the surface layer is sand. In a few areas the soil is dark to a depth of more than 20 inches.

Included with these soils in mapping are small areas of Anselmo, Boelus, and Ipage soils. Anselmo soils have more clay in the subsoil than the Dunday soil. Their positions on the landscape are similar to those of the Dunday soil. Boelus and Ipage soils are in the lower areas. Boelus soils have loamy and silty underlying material. Ipage soils have mottles within a depth of 40 inches. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Valentine and Dunday soils, and the available water capacity is low. Organic matter content is low in the Valentine soil and moderately low in the Dunday soil. The water intake rate is very high in both soils. Runoff is slow. The soils can be easily tilled throughout a wide range in moisture content.

A large acreage of these soils supports native grasses and is used for grazing. The rest is used mainly for irrigated crops. Some areas are cultivated along with large areas that are arable. Because of droughtiness and the hazard of soil blowing, these soils are generally unsuited to dryland crops. If irrigated, they are poorly suited to corn, alfalfa, introduced grasses, and small grain. A sprinkler system is the only suitable method of irrigation. The soils are too sandy for gravity irrigation. Frequent, light applications of water are needed. One large application can result in the leaching of plant nutrients below the root zone. Unless the surface is protected by crops or crop residue, soil blowing is a hazard. It can be controlled by field windbreaks, stubble mulch tillage, and winter cover crops. Leaving the maximum amount of crop residue on the surface helps to control soil blowing in winter and spring. Grazing of the crop residue should be restricted. Applications of fertilizer are needed.

In the areas used as range, the climax vegetation on the Valentine soil is dominated by sand bluestem, prairie sandreed, little bluestem, sand lovegrass, and needleandthread. These species make up 75 percent or more of the total annual production on this soil. Blue grama, indiangrass, sand dropseed, switchgrass, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, hairy grama, sedges, sandhill muchly, annual grasses, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. Under these conditions, excessive soil blowing occurs and blowouts form.

The climax vegetation on the Dunday soil is dominated by sand bluestem, prairie sandreed, little bluestem, needleandthread, and blue grama. These species make up 70 percent or more of the total annual production on this soil. Sand dropseed, indiangrass, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, little bluestem, sand lovegrass, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, sand dropseed, blue grama, sedges, sandhill muhly, annual grasses, and forbs. If overgrazing continues for many years, bluegrass, Scribner panicum, sand dropseed, needleandthread, and numerous annual and perennial weeds dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.8 animal unit month per acre on the Valentine soil and 0.9 animal unit month per acre on the Dunday soil. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trials. The steeper slopes and the areas away from the watering facilities may be underused. These generally are the first soils to be overgrazed when they are grazed in conjunction with the steeper Valentine soils. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable native grass mixture.

If these soils are used as hayland, the forage should be harvested only every other year. During the following year, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. The resulting plant cover helps to hold snow on the surface and thus increases the moisture supply. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

These soils are suited to some of the trees and shrubs grown as windbreaks. The only suitable species are those that can withstand droughty conditions. A scarcity of moisture and the hazard of soil blowing are the main problems. Irrigation is needed during periods of low rainfall. The Valentine soil is so loose that seedlings should be planted in shallow furrows with as little disturbance of the surface as possible. Young seedlings can be damaged by windblown sand. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the tree rows. Competition for moisture from weeds and undesirable grasses is a problem. Weeds can be controlled by cultivation. The areas near the trees can be hoed by hand or rototilled.

These soils are suitable as sites for dwellings and local roads. They readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Lining or sealing sewage lagoons helps to prevent seepage. The sides of shallow excavations can cave in unless they are temporarily shored.

The land capability units are VIe-5, dryland, and IVe-11, irrigated. The Valentine soil is in the Sands range site and in windbreak suitability group 7. The Dunday soil is in the Sandy range site and in windbreak suitability group 5.

VmD—Valentine-Els fine sands, 0 to 9 percent slopes. These deep soils are in valleys in the sandhills. The excessively drained, gently sloping to strongly sloping Valentine soil formed in sandy windblown material on low dunes. The deep, nearly level, somewhat poorly drained Els soil formed in mixed eolian and alluvial sandy material in swales between the dunes. It is subject to rare flooding. Areas range from 10 to 300 acres in size. They are 50 to 65 percent Valentine soil and 20 to 35 percent Els soil. The two soils occur as areas so intricately mixed that separating them in mapping is not practical.

Typically, the Valentine soil has a surface layer of grayish brown, loose fine sand about 5 inches thick. The transition layer is light brownish gray, loose fine sand about 6 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand. In a few places the surface layer is loamy sand or loamy fine sand.

Typically, the Els soil has a surface layer of dark grayish brown, very friable fine sand about 6 inches thick. The transition layer is grayish brown, loose fine sand about 10 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand that has strong brown mottles. In a few places the surface layer is loamy fine sand. In a few areas loamy or gravelly material is below a depth of 20 inches.

Included with these soils in mapping are small areas of Ipage, Marlake, and Tryon soils. The moderately well drained Ipage soils are in areas between the Valentine and Els soils. The very poorly drained Marlake and poorly drained or very poorly drained Tryon soils are in the lower positions on the landscape. Also included are blowouts and some areas of the Valentine soils that have a slope of more than 9 percent. Included areas make up 10 to 15 percent of the unit.

Permeability is rapid in the Valentine and Els soils, and the available water capacity is low. Organic matter

content is low in the Valentine soil and moderately low in the Els soil. The water intake rate is very high in both soils. Runoff is slow or very slow. The depth to the seasonal high water table in the Els soil ranges from about 1.5 feet in wet years to 3.0 feet in dry years.

Most of the acreage supports native grasses and is used as range or hayland. A small acreage is used for irrigated crops. Because of droughtiness and the hazard of soil blowing, these soils are generally unsuited to dryland crops. If irrigated, they are suited to small grain, alfalfa, and introduced grasses. Also, corn and soybeans can be grown in areas where the slope is less than 6 percent. The soils are unsuitable for gravity irrigation but can be irrigated by sprinklers. The Els soil is commonly too wet for cultivation during the wettest periods. During dry years, however, the crops can benefit from subirrigation in this soil. A drainage system is needed in some areas. Unless the surface is protected by crops or crop residue, soil blowing is a hazard. It can be controlled by planting winter cover crops and close-growing crops and by leaving crop residue on the surface. Grazing of crop residue should be restricted. Applying barnyard manure increases the organic matter content and improves fertility.

These soils are suited to range. The climax vegetation on the Valentine soil is dominated by sand bluestem, prairie sandreed, little bluestem, and needleandthread. These species make up 75 percent or more of the total annual production on this soil. Blue grama, indiangrass, sand dropseed, switchgrass, sedges, and other annual and perennial grasses, forbs, and shrubs make up the rest. Under continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, switchgrass, and indiangrass decrease in abundance. Initially, these species are replaced by needleandthread, prairie sandreed, hairy grama, sand dropseed, sedges, sandhill muhly, annual grasses, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. Under these conditions, excessive soil blowing occurs and blowouts form.

The climax vegetation on the Els soil is dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges and rushes. These species make up 80 percent or more of the total annual production on this soil. Plains bluegrass, slender wheatgrass, western wheatgrass, and forbs make up the rest. Under continuous heavy grazing or improper haying, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, foxtail barley, slender wheatgrass, green muhly, and various sedges and rushes. Timothy, redtop, and clover also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, clover, and other forbs, such as Baldwin ironweed, dominate the site. When the surface layer is wet, overgrazing and heavy machinery traffic can cause surface compaction and the formation of small mounds and ruts, which hinder grazing and haying.

If the range is in excellent condition, the suggested initial stocking rate is 0.8 animal unit month per acre on the Valentine soil and 1.7 animal unit months per acre on the Els soil. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities. The areas away from the watering facilities may be underused. The Els soil is generally grazed more heavily than the Valentine soil. Properly located fences, livestock water, and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided help to prevent excessive trampling and local overuse.

If properly managed, a cover of range plants is very effective in controlling soil blowing and water erosion. Abandoned cropland should be reseeded to a suitable native grass mixture.

If these soils are used as hayland, mowing should be regulated so that the grasses remain vigorous. It should be avoided during the period between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. For the dominant grasses, the maximum storage of these food reserves is completed by the frost period. The quality of the hay is higher when the grasses are cut earlier. After the soil is frozen, livestock can graze without damaging the meadows. They should be removed before the frost leaves the soil in the spring. A proper mowing height helps to maintain the stand of grasses and high forage production. It should not be less than 3 inches.

These soils are suited to the trees and shrubs grown as windbreaks. The Valentine soil is so loose, however, that seedlings should be planted in shallow furrows with as little disturbance of the surface as possible. Young seedlings can be damaged by windblown sand. Strips of sod are needed between the tree rows. The species selected for planting on the Els soil should be those that can withstand occasional wetness. Establishing trees can be difficult during wet periods. Weeds and undesirable grasses can be controlled by cultivating with conventional equipment. The areas near the trees can be rototilled or hoed by hand.

These soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Fill material can elevate absorption fields and the bottom of sewage lagoons a sufficient distance above the seasonal high water table in the Els soil. Lining or

sealing the lagoon helps to prevent seepage. In areas of the Els soil, the lagoon should be diked because of the hazard of flooding.

The sides of shallow excavations in these soils can cave in unless they are temporarily shored. Excavations in the Els soil should be made during dry periods. The Valentine soil is suitable as a site for dwellings and local roads. Dwellings on the Els soil should be constructed on elevated, well compacted fill material, which helps to protect the site against flooding and helps to overcome the wetness caused by the seasonal high water table.

Wetness, flooding, and frost action are limitations if the Els soil is used as a site for local roads and streets. Building the roads on suitable, well compacted fill material and providing adequate side ditches and culverts help to prevent the road damage caused by flooding and wetness. The damage caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and establishing adequate side ditches help to provide the needed surface drainage.

The land capability units are VIe-5, dryland, and IVe-12, irrigated. The Valentine soil is in the Sands range site and in windbreak suitability group 7. The Els soil is in the Subirrigated range site and in windbreak suitability group 2S.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 7,700 acres in the survey area, or 2 percent of the total acreage, meets the soil requirements for prime farmland. A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; for windbreaks; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

By William E. Reinsch, conservation agronomist, and Orville Indra, soil scientist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Most of the land in Wheeler County is used for agricultural purposes. Less than 25 percent of the farmland is used as cropland. Corn is the chief crop.

Management for Dryland Crops

Many of the soils in Wheeler County are suitable for dryland crops. Good management of the areas used for these crops reduces the runoff rate and the hazards of soil blowing and water erosion, conserves moisture, and improves tilth.

Water erosion reduces crop production and results in sedimentation. Productivity is reduced when the fertile surface layer is lost and part of the subsoil, which is lower in content of organic matter, is incorporated into the surface layer. When erosion occurs, sediment rich in nutrients enters streams and ponds. Measures that control water erosion minimize this pollution. They also reduce the amount of fertilizer needed in cropped areas by helping to prevent the removal of plant nutrients.

Terraces, contour farming, grassed waterways, and conservation tillage systems that keep crop residue on the surface help to control water erosion, increase the water intake rate, reduce the runoff rate, and conserve moisture. Keeping crop residue on the surface or establishing a protective plant cover minimizes sealing and crusting during and after heavy rains. In winter stubble catches drifting snow and thus increases the moisture supply.

Soil blowing is a major hazard in Wheeler County. It can be controlled by crop residue management,

conservation tillage, contour stripcropping, and field windbreaks. The overall hazard of erosion can be reduced if the more productive soils are used for row crops and the steeper, more erosive soils are used for close-grown crops, such as small grain, alfalfa, or grasses for hay and pasture. In many areas excessive soil loss can be prevented only by proper land use.

Insufficient rainfall commonly limits crop production in Wheeler County. A cropping system and management practices that prevent excessive soil loss and conserve moisture are needed on all cropland in the county. Proper management practices and a suitable cropping sequence help to maintain tilth and fertility, help to maintain a plant cover that protects the soil against erosion, and control weeds, insects, and diseases.

The management practices and cropping sequence vary, depending on the kind of soil. For example, the management practices on Dunday loamy fine sand, 3 to 6 percent slopes, should include a conservation tillage system of row crop production. In row cropped areas of Uly silt loam, 3 to 6 percent slopes, terraces, contour farming, and crop residue management are needed to control water erosion and soil blowing and to maintain fertility and tilth. In cultivated areas of class II soils, such as Hord silt loam, 1 to 3 percent slopes, and of class III soils, such as Anselmo fine sandy loam, 2 to 6 percent slopes, leaving crop residue on the surface throughout the winter, adding fertilizer or feedlot manure, and applying a system of conservation tillage help to control erosion. On class IVe-5 soils, such as Dunday loamy fine sand, 0 to 3 percent slopes, erosion can be controlled by leaving crop residue on the surface throughout the winter and by applying a system of conservation tillage that leaves 50 percent of the corn, sorghum, or small grain residue on the surface after planting.

Care is needed when a seedbed is prepared or weeds are removed through cultivation. Excessive tillage breaks down the granular structure of the surface layer and thus results in deterioration of tilth. Steps in the tillage process should be limited to those that are essential. Various conservation tillage practices can be used in the county. No-till, till-plant, disk-plant, and chisel-plant, for example, are well suited to the soils used for row crops. Grasses can be planted by drilling into a cover of stubble without further seedbed preparation.

On all soils that are used for cultivated crops or for pasture, soil tests are needed to determine the need for additional plant nutrients. The kind and amount of fertilizer to be applied should be based on the results of these tests and on the moisture content of the soil when the fertilizer is applied. If the subsoil is dry or rainfall is below normal, the amount of nitrogen fertilizer applied should be slightly reduced. Nitrogen fertilizer is beneficial on all soils used for nonlegume crops. Phosphorus and zinc are needed on the more eroded soils and in areas that have been cut during the construction of terraces or diversions. Dryland crops require smaller amounts of fertilizer than irrigated crops because the plant population is generally lower.

Some soils in Wheeler County are somewhat poorly drained because of a moderately high water table. Open drainage ditches and underground tile can lower the water table if suitable outlets are available. If the water table cannot be lowered sufficiently for good crop growth, the crops selected for planting should be those that can withstand wet conditions.

Management for Irrigated Crops

About 60 percent of the cropland in Wheeler County was irrigated in 1982 (*4*). More than 90 percent of the irrigated cropland was used for corn. The rest was used for alfalfa. Either furrow or sprinkler systems are suitable in the areas used for corn or other row crops. Alfalfa can be irrigated by border, contour ditch, corrugation, or sprinkler systems.

The cropping sequence on soils that are well suited to irrigation is dominated by row crops. Including alfalfa and grasses in the cropping sequence helps to control the plant diseases and insects that are common if the same crop is grown year after year. Cultivated areas of Dunday loamy fine sands, Ipage loamy sands, and Valentine fine sands are highly susceptible to soil blowing. If these soils are irrigated, crop residue should be left on the surface until the spring crop is planted. A minimum of 3,500 pounds of standing cornstalks per acre is needed. The cornstalks should be about 16 inches tall. The protective cover of crop residue not only helps to prevent excessive soil loss but also helps to conserve the supply of irrigation water by reducing the runoff and evaporation rates and increasing the water intake rate.

If a sprinkler system is used, water should be applied at a rate that allows the soil to absorb the water and that does not result in excessive runoff. Sprinklers can be used on the more sloping soils as well on nearly level ones. They can be used on coarse textured soils, such as Dunday loamy fine sand, 3 to 6 percent slopes, if measures that control soil blowing are applied. In summer much of the water is lost through evaporation. Wind drift can result in an uneven distribution of water. Watering at night, when wind velocities are usually lowest and temperatures are lower, reduces the amount of water lost through evaporation and improves water distribution.

Because soil holds a limited amount of water, irrigation water or precipitation is needed at regular intervals to keep the soil moist. The interval between applications varies, depending on the crop, the soil, and the amount of moisture in the soil. The application rate should not exceed the water intake rate of the soil.

Sandy soils in Wheeler County hold about 1 inch of available water per foot of soil. A soil that is 4 feet deep and is planted to a crop that has roots extending to a depth of 4 feet supplies about 4 inches of available

water to the crop. For maximum efficiency, irrigation should be started when about half of the available water has been used by the plants. The irrigation system should replace water at a rate that ensures a stable water supply for the plants.

Irrigated soils generally produce higher yields than nonirrigated soils. Consequently, the plants remove more nutrients, particularly nitrogen and phosphorus. Returning all crop residue to the soil and adding feedlot manure and commercial fertilizer help to maintain the supply of plant nutrients. Most of the grain crops grown in Wheeler County respond well to applications of nitrogen fertilizer. In areas where the surface has been disturbed by land leveling, particularly where the topsoil has been removed, plants respond well to applications of phosphorus, zinc, and iron. The kinds and amounts of fertilizer needed for specific crops should be determined by soil tests.

The soils in Wheeler County that are suitable for irrigation are assigned to irrigation design groups. These groups are described in an irrigation guide for Nebraska (*7*). If applicable, an irrigation capability unit is specified at the end of the description under the heading "Detailed Soil Map Units." The Arabic number at the end of the irrigated capability unit indicates the design group to which the soil is assigned.

Assistance in planning and designing an irrigation system can be obtained from the local office of the Soil Conservation Service or from the Cooperative Extension Service.

Weed Control

Weeds can be controlled by a proper cropping sequence. Rotating different crops in a planned sequence not only helps to control weeds but also increases productivity and the organic matter content.

Applications of herbicide also are effective in controlling weeds. The kind and amount of herbicide to be applied should be determined by the kind of soil. The colloidal clay and humus fraction of the soil is responsible for most of the chemical activity in the soil. Applications of an excessive amount of herbicide can result in crop damage on sandy soils, which have a low content of colloidal clay, and on soils that are moderately low or low in content of organic matter.

Management of Pasture and Hayland

Hayland or pasture should be managed for maximum production. Once a pasture is established, the grasses should be kept productive. A planned grazing system that meets the needs of the plants and results in a uniform distribution of grazing is needed. Most forage plants are a good source of minerals, vitamins, protein, and other nutrients. A well managed pasture can provide a balanced ration throughout the growing season.

A mixture of suitable grasses and legumes can be grown on many kinds of soil. Grasses and legumes can be grown in rotation with grain crops. They improve soil structure and tilth, add organic matter, and help to control erosion. As a result, they are ideal for use in a conservation cropping system.

In both irrigated and nonirrigated areas of pasture and hayland, additional plant nutrients are needed before maximum vigor and growth can be achieved. The kinds and amounts of fertilizer needed should be determined by soil tests. The most commonly grown grasses on irrigated pastures are smooth brome and orchardgrass. Other grasses that are suitable for irrigation are intermediate wheatgrass, meadow brome, and creeping foxtail. The legumes that can be grown on irrigated or nonirrigated pastures include alfalfa, birdsfoot trefoil, and cicer milkvetch.

Irrigated pasture is an economic alternative to irrigated cropland. Converting cropland to irrigated pasture helps to control erosion.

The grasses that can be grown on nonirrigated pasture include smooth brome, intermediate wheatgrass, meadow brome, tall fescue, and orchardgrass. When planted as a single species on nonirrigated land, some native, warm-season grasses can be grown on cool-season pastures to improve forage quality during the grazing season. Switchgrass, indiangrass, and big bluestem are examples of native, warm-season grasses that can provide high-quality forage during the summer if a planned grazing system is applied.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops

grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, Vw-7 or IVe-5.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Rangeland

Prepared by Peter N. Jensen, range conservationist, Soil Conservation Service.

Range makes up approximately 72 percent of the total agricultural land in Wheeler County. It is throughout the county. The greatest concentration is in the Valentine and Dunday-Valentine-Boelus soil associations (fig. 14), which are described under the heading "General Soil Map Units." The Elsmere-Loup-Ipage, Els-Valentine-Ipage, and Valentine-Els associations are used dominantly for either grazing or native hay. The sandy soils on uplands are used mainly for range. In some areas of these soils, center-pivot systems irrigate corn or alfalfa hay. The ranches in Wheeler County average about 3,000 acres in size. Some are 25,000 acres or more.

Raising of livestock is the largest agricultural industry in the county. The livestock are mainly cow and calf herds. The calves are sold in the fall as feeders. The range is generally grazed from late spring to early fall. In the fall livestock graze the regrowth of native meadows or corn residue on irrigated cropland. They are fed native or alfalfa hay during the winter and early spring. Also, the forage from range is supplemented by protein in the fall and winter.

Figure 14.—An area of Valentine loamy fine sand, 0 to 3 percent slopes, used as range.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 8 shows, for nearly every soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 8 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important. Most of the range in Wheeler County is in the Wet Subirrigated, Subirrigated, Sandy, Sands, and Choppy Sands range sites. The remaining areas are in the Wetland, Saline Subirrigated, Sandy Lowland, Silty, Limy Upland, Thin Loess, Silty Overflow, and Silty Lowland range sites.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter

of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Some of the range in Wheeler County has been overgrazed. Approximately 60 percent of the range is producing less than half of its potential in kind or amount of native plants. This decreased production is largely the result of the overuse caused by overstocking and poor livestock distribution.

Range management that maintains or improves the range condition is needed on all range used for grazing. It includes (1) proper grazing use that maintains an adequate cover of vigorous plants; (2) deferred grazing, or resting grazing land during the carbohydrate storage period of the key plants; and (3) a planned grazing system, whereby the pastures are alternately grazed and rested in a planned sequence. Also, properly locating fences, providing livestock watering facilities, such as wells and stock ponds, and moving salt to areas where grazing is desired help to achieve a more uniform distribution of grazing.

On certain Sandy and Sands range sites, production on abandoned cropland, dryland or irrigated, can be improved by planting a mixture of suitable native grasses. After establishment, production can be maintained by proper management. Enclosing unstabilized blowouts with fences and shaping, seeding, and mulching them help to protect the grasses in adjacent areas from windblown sand.

Native meadows make up a significant percentage of the range in Wheeler County. They are used for the production of native hay. The range is generally used for meadow, however, in areas where the water table is high. These areas are assigned to the Wetland, Wet Subirrigated, Subirrigated, and Saline Subirrigated range sites. The dominant vegetation is big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, reedgrasses, and various sedges. Mowing has reduced the formerly large population of native wild flowers.

Forage production on native meadows can be maintained or improved by proper management. The optimum time for mowing is prior to the flowering period of the grasses. The maximum storage of carbohydrates occurs during the period when the seed is mature. This period coincides with the frost period for the dominant grasses. A proper mowing height helps to maintain the stand of grasses and high forage production. Mowing closer than 3 inches reduces plant vigor.

Meadows should not be grazed when the water table is within a depth of 6 inches. Grazing when the soil is wet causes the formation of small bogs or mounds, which hinder mowing during subsequent years. Meadows can be grazed after frost following the hay harvest.

Technical assistance in managing range and hayland can be obtained from the local office of the Soil Conservation Service.

Native Woodland

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

Trees are abundant in Wheeler County, especially on the bottom land. Only a small percentage of the trees are native. The woodland generally occurs as clumps or narrow strips of trees in wet areas. Also, some block plantings have been made on timber claims and on blowouts.

Eastern cottonwood and black willow grow well along the major drainageways and in other wet areas. The block plantings on blowouts consist of eastern redcedar, jack pine, and ponderosa pine. The trees on timber claims are black locust, eastern cottonwood, and green ash. They generally were planted in areas where the water table is within reach of the tree roots.

Some of the trees are cut for firewood and lumber, but commercial use of the woodland for wood products is very limited. The wooded areas are not large enough to be of commercial value.

Windbreaks and Environmental Plantings

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

Trees have been planted at various times on most farmsteads and ranch headquarters in Wheeler County. Windbreaks that protect livestock in areas away from the headquarters also are important. Eastern redcedar and eastern cottonwood are the most common trees in windbreaks (fig. 15). Other common species are Siberian elm, green ash, hackberry, honeylocust, jack pine, and ponderosa pine.

New windbreaks are continually needed because old trees pass maturity and deteriorate and because some trees are destroyed by insects, diseases, or storms. Also, new windbreaks are needed in areas where farming or ranching is expanding.

Field windbreaks or shelterbelts are numerous throughout the county. Some consist of 8 to 10 rows of trees and shrubs, while others are a single row of trees along a road, field boundary, or property line. Many field windbreaks were planted under the Prairie States Tree Planting Program in the 1930's and 1940's.

The multiple-row shelterbelts consist of eastern redcedar, ponderosa pine, Russian mulberry, American plum, black locust, honeylocust, green ash, hackberry, Siberian elm, and eastern cottonwood. Most of the single-row or narrow field windbreaks consist of eastern redcedar and eastern cottonwood. Eastern redcedar commonly grows in the understory of large cottonwood trees.

Many field windbreaks and shelterbelts were removed when fields were enlarged so that they could accommodate center-pivot irrigation systems. Also, some windbreaks have reached maturity and are deteriorating.

Figure 15.—Farmstead and field windbreaks of eastern redcedar on Dunday and Valentine soils.

Renovation through thinning, removal, and replanting is needed. Planting in the corners or around the borders of the irrigated fields can compensate for some of the trees that have been removed.

In order for windbreaks and environmental plantings to fulfill their intended purpose, the species selected for planting should be suited to the soil on the site. Selecting suitable species helps to ensure survival and a maximum growth rate. Permeability, available water capacity, fertility, soil texture, soil depth, and drainage greatly affect the growth rate.

Establishing trees and shrubs is somewhat difficult in Wheeler County because of dry conditions and competition from other vegetation. Proper site preparation before planting and control of plant competition after planting are important management concerns. Supplemental watering is needed when the seedlings are becoming established. Dead trees should be replaced.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

At the end of each description under the heading "Detailed Soil Map Units," the soil has been assigned to a windbreak suitability group. These groups are based primarily on the suitability of the soil for the locally adapted species, as is indicated by their growth and vigor. Detailed interpretations for each windbreak suitability group in the county are provided in the Technical Guide, which is available in the local office of the Soil Conservation Service.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

Hunting and fishing on private land are the primary recreational activities in Wheeler County (fig. 16). Two recreational areas are in the extreme southern part of the county. One is Pibel Lake, which is managed by the Nebraska Game and Parks Commission. This area is made up of 48 acres of land and a 24-acre lake. Picnicking and camping are permitted. A boat ramp is available. Fishing and hunting are permitted during the regular seasons. Other activities include hiking and bird watching. The other area is Ericson Lake, which provides opportunities for swimming, fishing, and boating. The areas along the lake are used as sites for vacation homes.

Assistance in designing farm ponds and recreational areas is available at the local office of the Soil Conservation Service.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best

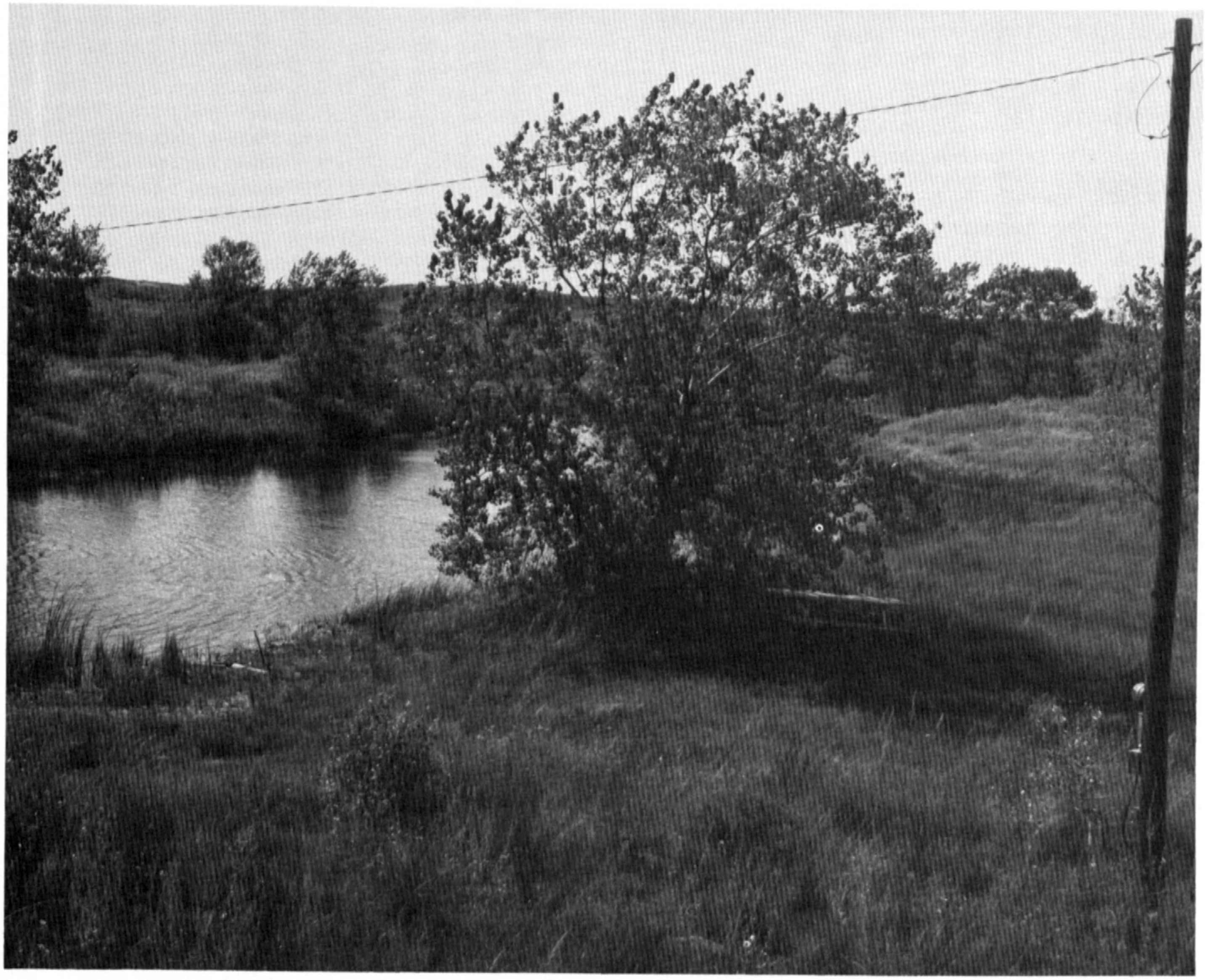

Figure 16.—Blownout land that has been vegetated and developed as a site for a lake.

soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and

are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

The kinds of wildlife habitat in Wheeler County vary, depending on the soil, topography, vegetation, slope, and drainage pattern. Rangeland wildlife is dominant in the sandhills. Mule deer and whitetail deer are the main big game species in these areas. Prairie grouse is the major upland game species. In cropped areas that are irrigated by center-pivot systems, fields of corn and alfalfa provide food and cover for pheasant and bobwhite quail. Farmstead shelterbelts and field windbreaks provide food and winter cover for many wildlife species. Mourning doves are throughout the county, especially in areas where open water is available.

Many of the blowouts in the sandhills have been stabilized with grass and some with eastern redcedar, ponderosa pine, and jack pine. These areas provide escape and winter cover for deer.

Swales in areas of the Valentine-Els association provide habitat for waterfowl and shore birds. This association is described under the heading "General Soil Map Units." The bottom land along the main stream corridors of Cedar, Beaver, and Clearwater Creeks is used as native hayland because the seasonal high water table usually prohibits farming. The southeast corner of the county generally is farmed. It consists of well drained, silty soils in the Coly-Uly and Hobbs-Hord associations. The bottom land adjacent to Clear Creek and Mud Creek is fertile and produces good crops, both dryland and irrigated. This area provides openland habitat for pheasant, bobwhite quail, deer, squirrels, and cottontail rabbits.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are intermediate wheatgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big bluestem, little bluestem, goldenrod, western wheatgrass, and blue grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are green ash, hackberry, Siberian elm, and eastern cottonwood. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, American plum, and common chokecherry.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness.

Examples of coniferous plants are ponderosa pine, eastern redcedar, and jack pine.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are Siberian peashrub, cotoneaster, and skunkbush sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, reed canarygrass, prairie cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, ring-necked pheasant, meadowlark, field sparrow, cottontail rabbit, and skunk.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, bobwhite quail, thrushes, woodpeckers, squirrels, raccoon, deer, and songbirds.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include badgers, deer, and prairie grouse.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if

slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable

material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content

of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution and plasticity. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

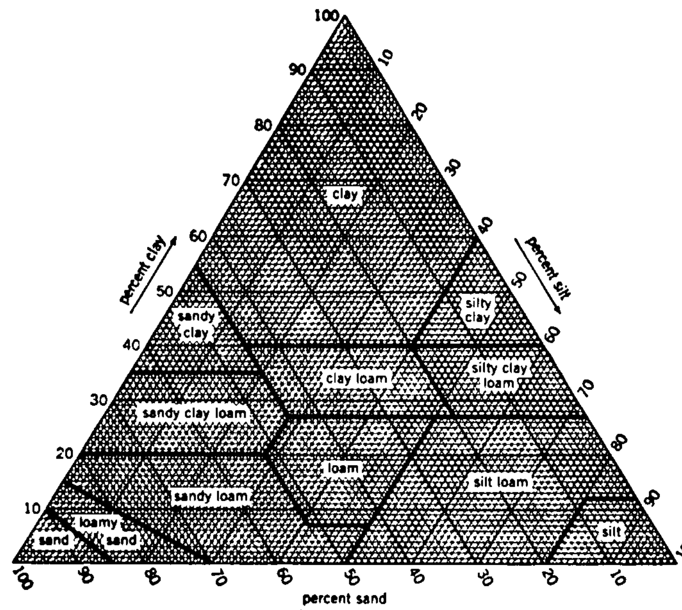

Figure 17.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 17). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*3*) and the system adopted by the American Association of State Highway and Transportation Officials (*2*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of

grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as

construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse

texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their

Morphology." The soil samples were tested by the Nebraska Department of Roads.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Specific gravity—T 100 (AASHTO). The group index number that is part of the AASHTO classification is computed by the Nebraska modified system.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Psamment (*Psamm*, meaning sand, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Ustipsamments (*Ust*, meaning intermittently dry, plus *Psamment*, the suborder of the Entisols that has a typic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Ustipsamments.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is mixed, mesic Typic Ustipsamments.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*5*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*6*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Anselmo Series

The Anselmo series consists of deep, well drained, moderately rapidly permeable soils on uplands and stream terraces. These soils formed in loamy eolian material. Slopes range from 0 to 6 percent.

Anselmo soils are similar to Hersh soils and are adjacent to Boelus, Dunday, Gibbon, and Valentine soils. Hersh soils do not have a mollic epipedon. Boelus soils are sandier in the upper part than the Anselmo soils and have loamy and silty underlying material. They are in landscape positions similar to those of the Anselmo soils. Dunday and Valentine soils are higher on the

landscape than the Anselmo soils. Also, they are sandier throughout. Gibbon soils are on bottom land and are somewhat poorly drained. They contain more clay throughout than the Anselmo soils.

Typical pedon of Anselmo fine sandy loam, 0 to 2 percent slopes, 1,600 feet east and 25 feet south of the northwest corner of sec. 31, T. 21 N., R. 10 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A—5 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; neutral; gradual smooth boundary.

Bw—16 to 22 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium and fine subangular blocky; slightly hard, very friable; neutral; gradual smooth boundary.

BC—22 to 28 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; soft, very friable; neutral; gradual smooth boundary.

C—28 to 60 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; weak coarse subangular blocky structure; soft, very friable; mildly alkaline.

The solum ranges from 12 to 38 inches in thickness. The mollic epipedon ranges from 7 to 20 inches in thickness. Reaction is medium acid to mildly alkaline throughout the profile.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is fine sandy loam, sandy loam, or loam. The Bw horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is fine sandy loam or sandy loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is fine sandy loam, loamy fine sand, fine sand, or sand.

Boelus Series

The Boelus series consists of deep, well drained soils formed in sandy eolian material and in the underlying loamy and silty sediments (fig. 18). These soils are on uplands. They are rapidly permeable in the upper part and moderately permeable in the lower part. Slopes range from 0 to 6 percent.

Boelus soils are commonly adjacent to Anselmo, Dunday, Ipage, Loretto, and Valentine soils. Anselmo and Loretto soils are lower on the landscape than the Boelus soils. Also, they contain less sand in the upper part. Dunday and Valentine soils are higher on the landscape than the Boelus soils. They are sandy throughout. Ipage soils are sandier throughout than the Boelus soils and are moderately well drained. They are

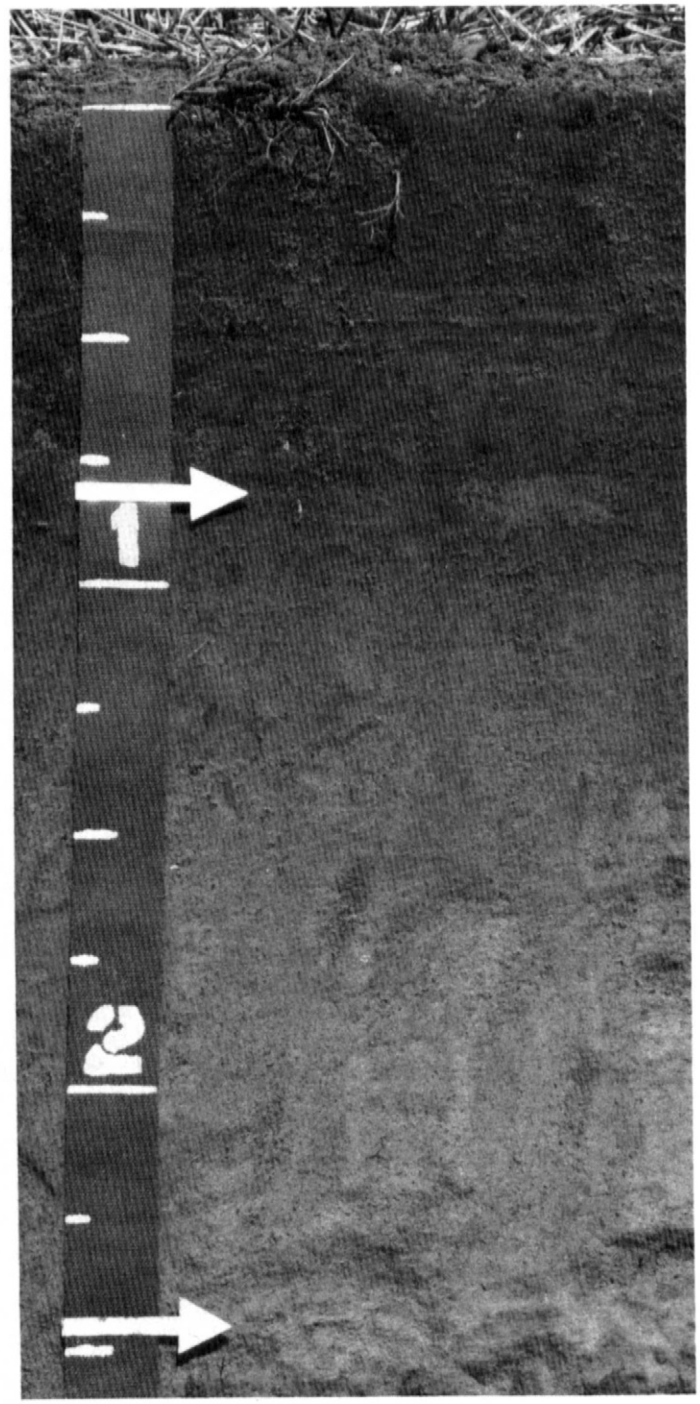

Figure 18.—Profile of Boelus loamy sand. The lower arrow indicates the depth to loamy and silty sediments. The upper arrow indicates the bottom of the surface layer. Depth is marked in feet.

in landscape positions similar to those of the Boelus soils.

Typical pedon of Boelus loamy sand, 0 to 3 percent slopes, 2,500 feet south and 50 feet east of the northwest corner of sec. 11, T. 24 N., R. 9 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A—6 to 14 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; slightly acid; clear smooth boundary.

AB—14 to 22 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; neutral; abrupt wavy boundary.

2Bw—22 to 34 inches; yellowish brown (10YR 5/4) sandy clay loam, dark brown (10YR 4/3) moist; common fine prominent dark brown (7.5YR 4/4 moist) relict mottles; weak medium prismatic structure parting to weak fine subangular blocky; hard, firm; neutral; gradual smooth boundary.

2C—34 to 60 inches; light yellowish brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) moist; few fine distinct yellowish brown (10YR 5/6 moist) relict mottles; massive; slightly hard, friable; neutral.

The solum ranges from 32 to 40 inches in thickness. The mollic epipedon ranges from 10 to 20 inches in thickness. The depth to the loamy 2Bw horizon is 20 to 36 inches. Some pedons have a C horizon above the 2Bw horizon. Reaction ranges from medium acid to moderately alkaline in the solum and from slightly acid to moderately alkaline in the 2C horizon.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loamy sand, but the range includes loamy fine sand. The AB horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 to 4. It is fine sand, loamy sand, or sand. The 2Bw and 2C horizons have hue of 10YR, 2.5Y, or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. They are very fine sandy loam, loam, silt loam, sandy clay loam, or silty clay loam. In some pedons the 2C horizon contains carbonates.

Coly Series

The Coly series consists of deep, well drained to excessively drained, moderately permeable soils on uplands. These soils formed in calcareous loess (fig. 19). Slopes range from 6 to 60 percent.

Coly soils are similar to Gates soils and are commonly adjacent to Hall, Hobbs, and Uly soils. Gates soils contain more sand than the Coly soils and do not have carbonates within 18 inches of the surface. Hall soils are in the more gently sloping areas. They have a mollic epipedon that is more than 20 inches thick and contain more clay in the subsoil than the Coly soils. Hobbs soils are stratified and are deeper to carbonates than the Coly soils. They are in drainageways and on canyon bottoms. Uly soils are on the smoother, longer slopes, commonly between high ridges and steep canyon breaks. In places they are on the lower side slopes. They are deeper to carbonates than the Coly soils and have a mollic epipedon.

Typical pedon of Coly silt loam, 17 to 30 percent slopes, 2,200 feet east and 1,000 feet south of the northwest corner of sec. 33, T. 21 N., R. 9 W.

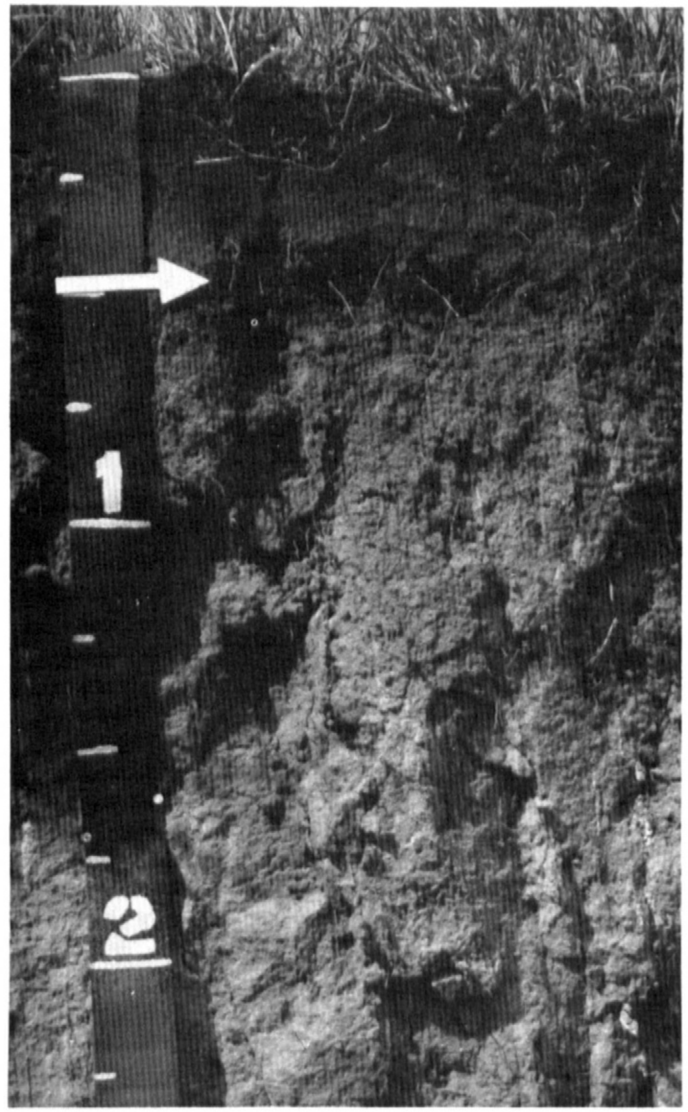

Figure 19.—Profile of Coly silt loam, which formed in loess. The arrow indicates the bottom of the surface layer. Depth is marked in feet.

A—0 to 4 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

AC—4 to 11 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure parting to weak medium and fine granular; soft, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

C—11 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; reddish brown (5YR 5/4) iron stains; massive; soft, very friable; fine threads and accumulations of carbonate; violent effervescence; moderately alkaline.

The solum ranges from 3 to 14 inches in thickness. The depth to free carbonates generally is 10 inches or less. The A horizon has value of 5 to 7 (3 to 5 moist) and chroma of 2 or 3. The AC and C horizons have value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3.

Dunday Series

The Dunday series consists of deep, well drained, rapidly permeable soils on uplands and stream terraces. These soils formed in sandy eolian material (fig. 20). Slopes range from 0 to 6 percent.

Dunday soils are commonly adjacent to Anselmo, Boelus, Ipage, and Valentine soils. Anselmo soils have more clay in the subsoil than the Dunday soils. They are in landscape positions similar to those of the Dunday soils. Boelus and Ipage soils are in the lower landscape positions. Boelus soils have loamy and silty underlying material. Ipage soils are moderately well drained and have mottles within a depth of 40 inches. Valentine soils are higher on the landscape than the Dunday soils. They do not have a mollic epipedon.

Typical pedon of Dunday loamy fine sand, 3 to 6 percent slopes, 200 feet south and 2,400 feet west of the northeast corner of sec. 11, T. 23 N., R. 9 W.

A1—0 to 9 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium and coarse granular structure; soft, very friable; slightly acid; gradual smooth boundary.

A2—9 to 14 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium and fine subangular blocky; soft, very friable; slightly acid; gradual smooth boundary.

AC—14 to 23 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; slightly acid; gradual smooth boundary.

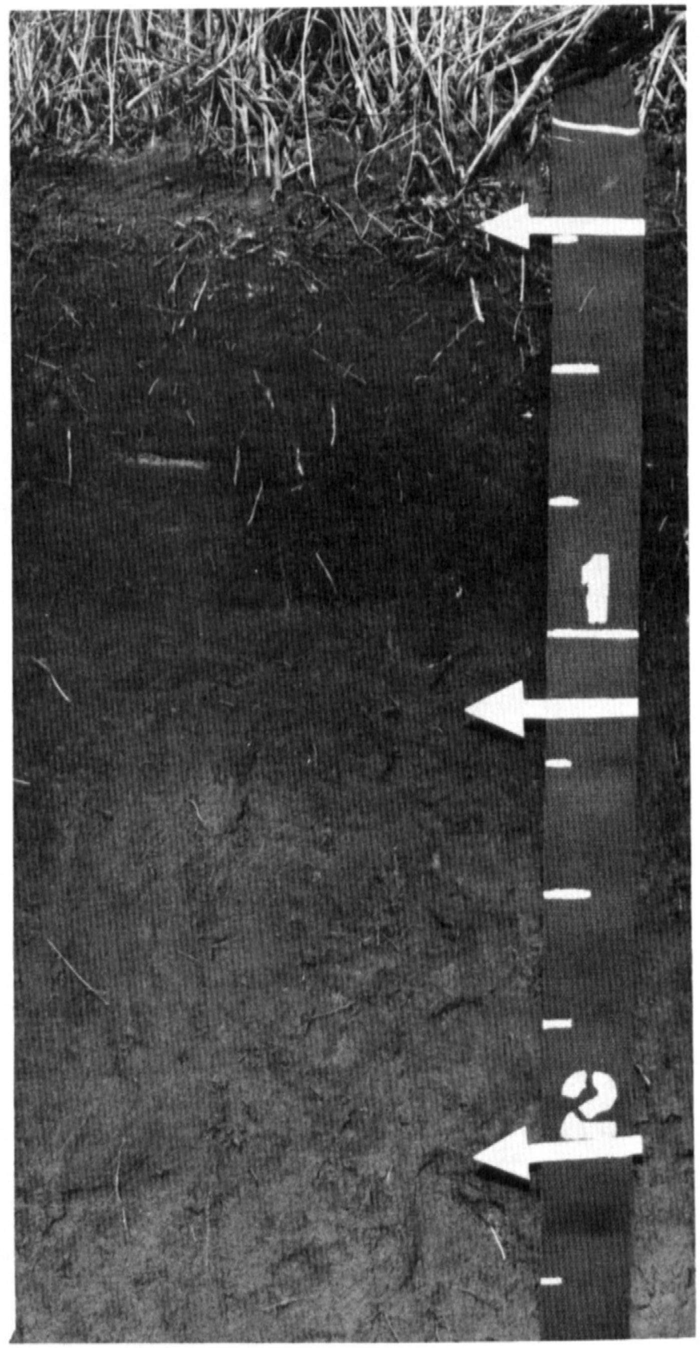

Figure 20.—Profile of Dunday loamy fine sand, which formed in sandy eolian material. The upper arrows indicate the surface soil and the lower arrow the bottom of the transition layer. Depth is marked in feet.

C1—23 to 38 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; neutral; gradual wavy boundary.

C2—38 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grain; loose; neutral.

The solum ranges from 14 to 30 inches in thickness. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is loamy fine sand but in some pedons is loamy sand. It is 10 to 16 inches thick. The AC horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is fine sand, loamy fine sand, loamy sand, or sand. In some pedons loamy or silty buried horizons are below a depth of 40 inches.

Els Series

The Els series consists of deep, somewhat poorly drained, rapidly permeable soils formed in mixed eolian and alluvial sandy material. These soils are on the bottom of valleys in the sandhills. Slopes range from 0 to 2 percent.

Els soils are similar to Elsmere soils and are commonly adjacent to Ipage, Tryon, and Valentine soils. Elsmere soils have a mollic epipedon. Ipage and Valentine soils are higher on the landscape than the Els soils and are better drained. Tryon soils are lower on the landscape than the Els soils and are more poorly drained.

Typical pedon of Els loamy sand, 0 to 2 percent slopes, 1,100 feet south and 300 feet west of the northeast corner of sec. 16, T. 23 N., R. 12 W.

A—0 to 7 inches; dark grayish brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

AC—7 to 16 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak medium and fine subangular blocky structure parting to weak fine granular; soft, very friable; slightly acid; gradual smooth boundary.

C—16 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; few fine prominent strong brown (7.5YR 5/6 moist) mottles; single grain; loose; neutral.

The solum ranges from 8 to 19 inches in thickness. The soils are slightly acid to moderately alkaline throughout.

The A horizon has value of 4 or 5 (3 moist) and chroma of 1 or 2. It is fine sand, loamy sand, or loamy fine sand. It ranges from 4 to 9 inches in thickness. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2. It is typically loamy sand, but in some pedons it is fine sand or loamy fine sand. The C horizon has value of 6 to 8 (5 to 7 moist) and chroma of 2 or 3. It has yellowish brown, strong brown, or dark reddish brown mottles. It is typically fine sand, but in some pedons it is sand or loamy sand.

Elsmere Series

The Elsmere series consists of deep, somewhat poorly drained, rapidly permeable soils formed in mixed eolian and alluvial sandy material (fig. 21). These soils are on bottom land and in sandhill valleys. Slopes range from 0 to 2 percent.

Elsmere soils are similar to Els soils and are commonly adjacent to Ipage, Loup, and Valentine soils. Els soils do not have a mollic epipedon. Ipage and Valentine soils are higher on the landscape than the Elsmere soils and are better drained. Loup soils are lower on the landscape than the Elsmere soils and are poorly drained or very poorly drained.

Typical pedon of Elsmere loamy fine sand, 0 to 2 percent slopes, 200 feet east and 50 feet north of the southwest corner of sec. 34, T. 24 N., R. 11 W.

A1—0 to 12 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable; neutral; abrupt smooth boundary.

A2—12 to 16 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; neutral; clear smooth boundary.

AC—16 to 24 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; neutral; clear smooth boundary.

C—24 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; common medium and coarse distinct yellowish brown (10YR 5/6 moist) mottles; single grain; loose; neutral.

The solum ranges from 16 to 28 inches in thickness. The mollic epipedon ranges from 10 to 20 inches in thickness. Reaction is medium acid to moderately alkaline throughout the profile. Carbonates are in some pedons.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is fine sand, loamy sand, loamy fine sand, or fine sandy loam. The AC horizon has value of 4 to 6 (3 or 4 moist) and chroma of 1 or 2. It is fine sand, loamy sand, or loamy fine sand. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It has few to many, fine to coarse, faint or distinct mottles that are yellowish brown, strong brown, or dark reddish brown. This horizon is fine sand, loamy sand, or sand. Some pedons have buried horizons.

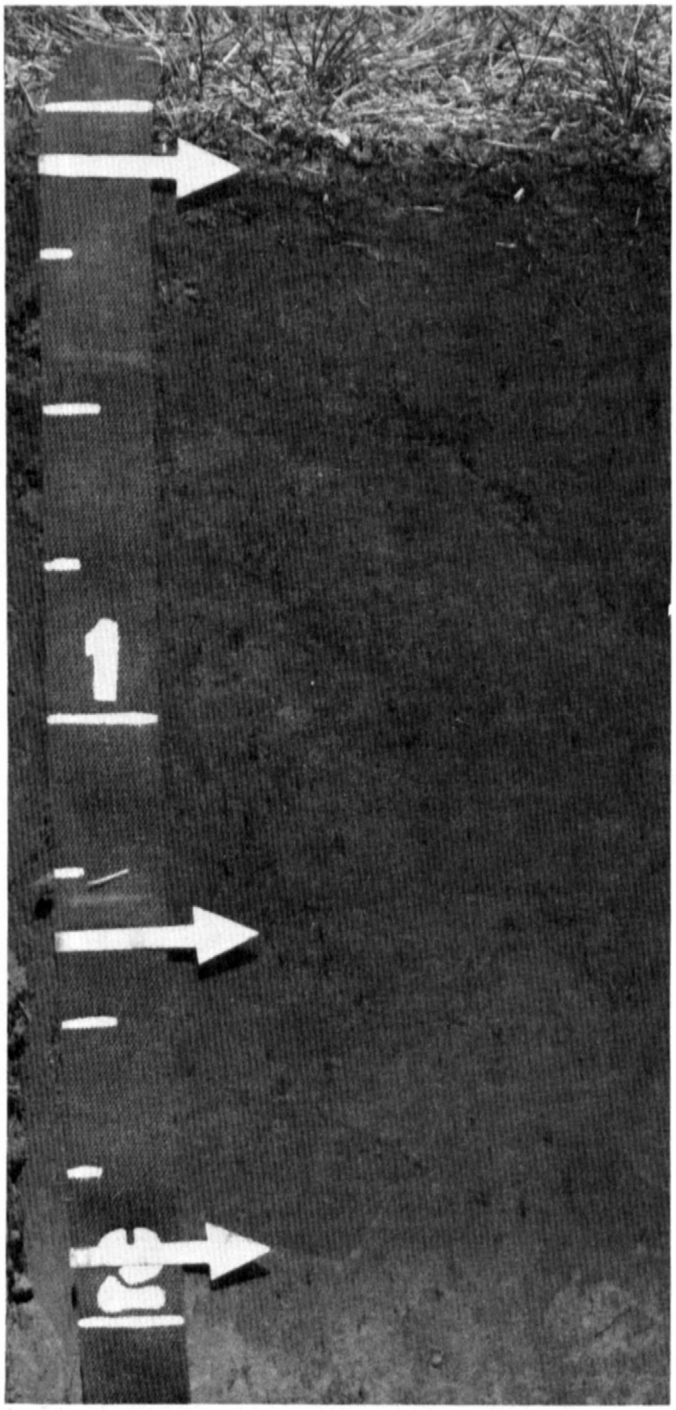

Figure 21.—Profile of Elsmere loamy fine sand, which formed in sandy material. The upper arrows indicate the surface soil and the lower arrow the bottom of the transition layer. Depth is marked in feet.

Gates Series

The Gates series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in reworked or recently deposited loess. Slopes range from 0 to 11 percent.

Gates soils are similar to Coly soils and are adjacent to Hersh and Valentine soils. Coly soils have more clay in the control section than the Gates soils and have calcium carbonates at or near the surface. Hersh soils have more sand throughout than the Gates soils. They are in landscape positions similar to those of the Gates soils. Valentine soils generally are higher on the landscape than the Gates soils. Also, they are sandier throughout.

Typical pedon of Gates very fine sandy loam, 6 to 11 percent slopes, 1,100 feet west and 500 feet north of the southeast corner of sec. 15, T. 21 N., R. 9 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) very fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

AC—5 to 18 inches; brown (10YR 5/3) very fine sandy loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; neutral; clear smooth boundary.

C1—18 to 26 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; slightly hard, very friable; few soft white accumulations of carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

C2—26 to 37 inches; pale yellow (2.5Y 7/4) very fine sandy loam, light olive brown (2.5Y 5/4) moist; slightly hard, very friable; many soft white accumulations of carbonate; violent effervescence; moderately alkaline; abrupt smooth boundary.

C3—37 to 60 inches; light gray (2.5Y 7/2) very fine sandy loam, light brownish gray (2.5Y 6/2) moist; slightly hard, very friable; many soft white accumulations of carbonate; violent effervescence; moderately alkaline.

The solum ranges from 7 to 22 inches in thickness. The depth to carbonates ranges from about 18 to 22 inches. Reaction is neutral to moderately alkaline in the surface layer and mildly alkaline or moderately alkaline in the lower part of the profile.

The A horizon has value of 5 to 7 (3 to 5 moist) and chroma of 1 to 3. It is very fine sandy loam or silt loam. It is 3 to 6 inches thick. The AC and C horizons have hue of 10YR or 2.5Y, value of 5 to 8 (4 to 6 moist) and chroma of 2 to 4. They are very fine sandy loam, silt loam, or loamy very fine sand.

Gibbon Series

The Gibbon series consists of deep, somewhat poorly drained, moderately permeable soils on bottom land. These soils formed in alluvium. Slopes range from 0 to 2 percent.

These soils have a slightly higher content of sand than is definitive for the Gibbon series. This difference, however, does not affect the usefulness or behavior of the soils.

Gibbon soils are commonly adjacent to Anselmo, Hord, Inavale, and Ord soils. The well drained Anselmo soils are on uplands. They are sandier throughout than the Gibbon soils. Hord soils are deeper to free carbonates than the Gibbon soils. Also, they are higher on the landscape. Inavale and Ord soils have more sand in the solum than the Gibbon soils. They are in landscape positions similar to those of the Gibbon soils.

Typical pedon of Gibbon loam, 0 to 2 percent slopes, 1,300 feet west and 900 feet north of the southeast corner of sec. 31, T. 21 N., R. 10 W.

Ap—0 to 5 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; slightly hard, friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

A1—5 to 15 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate fine granular structure; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

A2—15 to 20 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, friable; violent effervescence; mildly alkaline; clear smooth boundary.

AC—20 to 26 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; few fine distinct yellowish brown (10YR 5/6 moist) mottles; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

C1—26 to 40 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

C2—40 to 46 inches; gray (10YR 6/1) very fine sandy loam, dark gray (10YR 4/1) moist; few fine faint yellowish brown (10YR 5/4 moist) mottles; massive; slightly hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.

C3—46 to 60 inches; light gray (10YR 7/1) fine sandy loam, gray (10YR 5/1) moist; few fine faint yellowish brown (10YR 5/4 moist) mottles; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum ranges from 10 to 28 inches in thickness. The mollic epipedon ranges from 10 to 20 inches in thickness. The soils are calcareous at or near the surface.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is silt loam, loam, or very fine sandy loam. It is mildly alkaline or moderately alkaline. The AC horizon has value of 5 or 6 (3 or 4 moist) and chroma of 2 or 3. It is silt loam, loam, or fine sandy loam. The C horizon has value of 6 or 7 (4 or 5 moist) and chroma of 1 or 2. It is silt loam, loam, very fine sandy loam, or fine sandy loam. It is moderately alkaline or strongly alkaline. Buried horizons are common below a depth of 30 inches.

Hall Series

The Hall series consists of deep, well drained, moderately permeable soils on uplands and in valleys. These soils formed in loess. Slopes range from 1 to 3 percent.

Hall soils are similar to Hord soils and are commonly adjacent to Hord and Uly soils. The adjacent soils do not have an argillic horizon. Uly soils are dark to a depth of less than 20 inches. They are lower on the landscape than the Hall soils.

Typical pedon of Hall silt loam, 1 to 3 percent slopes, 2,200 feet east and 150 feet north of the southwest corner of sec. 36, T. 21 N., R. 9 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A—6 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate coarse prismatic structure parting to weak fine subangular blocky; slightly hard, friable; slightly acid; clear smooth boundary.

Bt1—12 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate fine subangular blocky; hard, firm; neutral; clear smooth boundary.

Bt2—24 to 31 inches; dark grayish brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

BC—31 to 38 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; mildly alkaline; gradual smooth boundary.

C1—38 to 44 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse

subangular blocky structure; slightly hard, friable; moderately alkaline; clear smooth boundary.

C2—44 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; few soft threadlike accumulations of carbonate; strong effervescence; moderately alkaline.

The solum ranges from 30 to 54 inches in thickness. The mollic epipedon ranges from 20 to 32 inches in thickness and extends into the upper part of the Bt horizon. Free carbonates do not occur in the solum but are in the C horizon in most pedons.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam, but the range includes loam and silty clay loam. This horizon is slightly acid or neutral. The Bt horizon has value of 3 to 5 (2 to 4 moist) and chroma of 1 to 3. It is slightly acid to mildly alkaline. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 or 3. It is neutral to moderately alkaline.

Hersh Series

The Hersh series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in mixed sandy and loamy eolian material. Slopes range from 0 to 3 percent.

Hersh soils are similar to Anselmo soils and are adjacent to Gates and Valentine soils. Anselmo soils have a mollic epipedon. Gates soils contain more silt in the control section than the Hersh soils. They are in landscape positions similar to those of the Hersh soils. Valentine soils are higher on the landscape than the Hersh soils. Also, they are sandier throughout.

Typical pedon of Hersh fine sandy loam, 0 to 3 percent slopes, 2,300 feet east and 1,700 feet south of the northwest corner of sec. 27, T. 21 N., R. 11 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

AC—6 to 14 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable; neutral; clear smooth boundary.

C1—14 to 26 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak medium and fine subangular blocky structure; soft, very friable; neutral; clear smooth boundary.

C2—26 to 36 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; neutral; clear smooth boundary.

C3—36 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grain; loose; neutral.

The solum ranges from 8 to 24 inches in thickness. Reaction is slightly acid or neutral in the surface layer and slightly acid to mildly alkaline in the lower part of the profile.

The A horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is 4 to 10 inches thick. It is dominantly fine sandy loam, but the range includes very fine sandy loam and loamy fine sand. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes loamy very fine sand. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, but most pedons have thin layers of silt loam, very fine sandy loam, loamy very fine sand, loamy fine sand, or fine sand.

Hobbs Series

The Hobbs series consists of deep, well drained, moderately permeable soils along upland drainageways and on bottom land along streams. These soils formed in stratified, silty alluvium. Slopes range from 0 to 2 percent.

Hobbs soils are adjacent to Coly, Hall, Hord, and Uly soils. Coly and Uly soils are on the higher, steeper parts of the landscape. Coly soils are not stratified. Uly soils have a weakly expressed B horizon and a mollic epipedon. Hall and Hord soils are higher on the landscape than the Hobbs soils. Also, Hall soils contain more clay in the subsoil. Hord soils are not stratified in the upper part.

Typical pedon of Hobbs silt loam, 0 to 2 percent slopes, 2,200 feet south and 50 feet east of the northwest corner of sec. 33, T. 21 N., R. 9 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A—5 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; mildly alkaline; abrupt smooth boundary.

C1—7 to 13 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; bedding planes and thin strata of loamy sand and fine sand; slightly hard, friable; mildly alkaline; gradual smooth boundary.

C2—13 to 34 inches; stratified light brownish gray (10YR 6/2) silt loam and very fine sandy loam, grayish brown (10YR 5/2) moist; weak fine and medium subangular blocky structure; soft, very friable; slight effervescence in thin strata; moderately alkaline; gradual smooth boundary.

C3—34 to 60 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; soft, very friable; moderately alkaline.

The depth to free carbonates typically is 40 inches or more. In most pedons, however, thin layers of recently deposited material have free carbonates.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silt loam, but in some pedons it is fine sandy loam. It is slightly acid to mildly alkaline. The C horizon typically has hue of 10YR or 2.5Y, value of 4 to 7 (3 to 6 moist), and chroma of 1 to 3, but thin strata may have higher or lower value. This horizon is typically silt loam, but it has thin strata of sandy or more clayey material. It ranges from slightly acid to moderately alkaline. A buried A horizon is common.

Hord Series

The Hord series consists of deep, well drained, moderately permeable soils formed in alluvium on stream terraces. Slopes range from 1 to 3 percent.

Hord soils are similar to Hall soils and are commonly adjacent to Hobbs and Hall soils. Hall soils have more clay in the subsoil than the Hord soils. They are on uplands. Hobbs soils are stratified and are on bottom land.

Typical pedon of Hord silt loam, terrace, 1 to 3 percent slopes, 1,550 feet east and 100 feet north of the southwest corner of sec. 25, T. 21 N., R. 9 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A—5 to 22 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable; slightly acid; clear smooth boundary.

Bw1—22 to 28 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable; mildly alkaline; clear smooth boundary.

Bw2—28 to 42 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

BC—42 to 48 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable; slight effervescence; moderately alkaline; gradual smooth boundary.

C—48 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The solum ranges from 30 to 55 inches in thickness. The mollic epipedon ranges from 20 to 50 inches in thickness. The depth to free carbonates ranges from 20 to 48 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silt loam, but the range includes loam and very fine sandy loam. This horizon is medium acid to neutral. The Bw horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silt loam, but the range includes loam and silty clay loam. This horizon is slightly acid to moderately alkaline. The C horizon has value of 5 to 7 (3 to 5 moist) and chroma of 2 or 3. It typically is silt loam, but the range includes very fine sandy loam. This horizon is mildly alkaline or moderately alkaline.

Inavale Series

The Inavale series consists of deep, somewhat excessively drained, rapidly permeable soils on bottom land. These soils formed in sandy alluvium. Slopes range from 0 to 2 percent.

Inavale soils are similar to Ipage soils and are adjacent to Loup and Tryon soils. Ipage soils are not stratified and have mottles within a depth of 40 inches. Loup and Tryon soils are lower on the landscape than the Inavale soils and are poorly drained and very poorly drained.

Typical pedon of Inavale loamy sand, in an area of Tryon-Inavale complex, channeled, 1,900 feet east and 75 feet south of the northwest corner of sec. 25, T. 23 N., R. 10 W.

A—0 to 6 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

AC—6 to 14 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; soft, very friable; thin strata of darker, finer textured sediments; neutral; clear smooth boundary.

C1—14 to 32 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; thin strata of dark grayish brown (10YR 4/2) material; neutral; gradual smooth boundary.

C2—32 to 60 inches; very pale brown (10YR 8/3) fine sand, very pale brown (10YR 7/3) moist; single grain; loose; neutral.

The solum ranges from 10 to 25 inches in thickness. Reaction is slightly acid to mildly alkaline in the surface layer and neutral to moderately alkaline in the lower part of the profile.

The A horizon has value of 4 or 5 (3 to 5 moist) and chroma of 2 or 3. It is loamy fine sand, loamy sand, fine sand, or sand. It is 5 to 9 inches thick. The C horizon has value of 5 to 8 (4 to 7 moist) and chroma of 2 or 3.

It is dominantly fine sand, loamy fine sand, loamy sand, or sand, but strata of finer or coarser textured material are common.

Ipage Series

The Ipage series consists of deep, moderately well drained, rapidly permeable soils formed in sandy eolian and alluvial material. These soils are on hummocky slopes, on low ridges in sandhill valleys, and on stream terraces. Slopes range from 0 to 3 percent.

Ipage soils are similar to Inavale soils and are commonly adjacent to Els, Elsmere, Loup, Tryon, and Valentine soils. Inavale soils are somewhat excessively drained and are on bottom land. Els and Elsmere soils are lower on the landscape than the Ipage soils and are somewhat poorly drained. Elsmere soils have a mollic epipedon. Loup and Tryon soils are on the lowest parts of the landscape and are poorly drained and very poorly drained. Valentine soils are higher on the landscape than the Ipage soils and are excessively drained. They do not have mottles within a depth of 40 inches.

Typical pedon of Ipage fine sand, in an area of Els-Ipage fine sands, 0 to 3 percent slopes, 2,300 feet east and 700 feet south of the northwest corner of sec. 18, T. 24 N., R. 11 W.

A—0 to 5 inches; grayish brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

AC—5 to 11 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; slightly acid; clear smooth boundary.

C1—11 to 32 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; slightly acid; gradual smooth boundary.

C2—32 to 60 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; common fine distinct yellowish brown (10YR 5/6 moist) mottles; single grain; loose; neutral.

The solum ranges from 3 to 21 inches in thickness. Reaction ranges from medium acid to neutral throughout the profile.

The A horizon has value of 4 to 6 (3 or 4 moist) and chroma of 1 or 2. It is sand, fine sand, loamy sand, or loamy fine sand. It is 3 to 10 inches thick. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is sand, fine sand, or loamy sand. The C horizon has value of 6 or 7 (4 to 6 moist) and chroma of 2 or 3. It has few or common, distinct or prominent mottles within a depth of 40 inches. The mottles are yellowish brown, strong brown, or dark reddish brown. This horizon is fine sand, sand, or loamy sand. Loamy layers are below a depth of 40 inches in some pedons.

Libory Series

The Libory series consists of deep, moderately well drained soils formed in sandy eolian material over loamy alluvium or loess. These soils are on stream terraces. They are rapidly permeable in the upper part and moderately permeable or moderately slowly permeable in the lower part. Slopes range from 0 to 3 percent.

Libory soils are adjacent to Dunday, Els, Ipage, and Valentine soils. Dunday, Ipage, and Valentine soils are sandier throughout than the Libory soils. Also, the well drained Dunday and excessively drained Valentine soils are higher on the landscape. Ipage soils are in landscape positions similar to those of the Libory soils. Els soils are lower on the landscape than the Libory soils and are somewhat poorly drained.

Typical pedon of Libory loamy fine sand, 0 to 3 percent slopes, 1,100 feet east and 900 feet north of the southwest corner of sec. 16, T. 21 N., R. 12 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A—5 to 13 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

C—13 to 25 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; few fine faint yellowish brown (10YR 5/4 moist) mottles; single grain; loose; slightly acid; abrupt smooth boundary.

2Bwb—25 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; common fine prominent dark yellowish brown (10YR 4/6 moist) mottles in the lower part; weak coarse subangular blocky structure parting to weak medium subangular blocky; hard, friable; slightly acid; gradual smooth boundary.

2C—42 to 60 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; few fine prominent dark yellowish brown (10YR 4/6 moist) mottles; massive; slightly hard; friable; neutral.

The mollic epipedon ranges from 10 to 20 inches in thickness. The depth to the silty 2B horizon ranges from 20 to 36 inches. Reaction is medium acid to neutral throughout the profile.

The A horizon has value of 3 to 5 (2 to 4 moist) and chroma of 1 or 2. It typically is loamy fine sand, but the range includes loamy sand and fine sand. The C, 2B, and 2C horizons have reddish brown, yellowish brown, or dark yellowish brown mottles. The C horizon has value of 6 or 7 (4 to 6 moist) and chroma of 2 or 3. It typically is fine sand, but the range includes loamy fine sand and loamy sand. Some pedons that have a thin solum do not

have a C horizon above the silty material. The 2B horizon has value of 4 to 6 (3 to 5 dry) and chroma of 2 or 3. It is silt loam or silty clay loam. The 2C horizon has hue of 2.5Y or 10YR, value of 4 to 7 (3 to 6 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. In some pedons it is calcareous.

Loretto Series

The Loretto series consists of deep, well drained, moderately permeable soils on stream terraces and uplands. These soils formed in loamy and silty eolian material. Slopes range from 0 to 2 percent.

Loretto soils are commonly adjacent to Boelus, Dunday, Gates, Hersh, and Valentine soils. Boelus soils are sandy in the upper part. They are in landscape positions similar to those of the Loretto soils. Dunday and Valentine soils are higher on the landscape than the Loretto soils. They are sandy throughout. Gates soils are slightly higher on the landscape than the Loretto soils. They are silty throughout. Hersh soils do not have a mollic epipedon and have more sand in the transition layer and in the underlying material than the Loretto soils. They are in landscape positions similar to those of the Loretto soils.

Typical pedon of Loretto loam, 0 to 2 percent slopes, 400 feet south and 100 feet east of the northwest corner of sec. 9, T. 24 N., R. 9 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; medium acid; abrupt smooth boundary.

A—7 to 13 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine subangular blocky; hard, friable; medium acid; clear smooth boundary.

Bt1—13 to 18 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; some very dark brown (10YR 3/2) coatings on faces of peds; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; slightly acid; gradual smooth boundary.

Bt2—18 to 26 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky; hard, firm; neutral; clear smooth boundary.

BC—26 to 30 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; hard, friable; few soft white lime accumulations; violent effervescence; mildly alkaline; gradual smooth boundary.

C—30 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; few soft white lime accumulations; violent effervescence; moderately alkaline.

The solum ranges from 27 to 50 inches in thickness. The mollic epipedon ranges from 7 to 20 inches in thickness. The depth to carbonates ranges from 26 to 54 inches.

The A horizon has value of 4 or 5 (2 or 3 moist). It is dominantly loam, but the range includes fine sandy loam. This horizon is strongly acid to slightly acid. The Bt horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is typically silty clay loam and clay loam, but in some pedons it is silt loam or loam. It is medium acid to neutral. The BC and C horizons have value of 6 or 7 (5 or 6 moist) and chroma of 3 or 4. They are silt loam, clay loam, silty clay loam, or loam. They range from slightly acid to moderately alkaline.

Loup Series

The Loup series consists of deep, poorly drained and very poorly drained, rapidly permeable soils formed in sandy alluvium (fig. 22). These soils are in sandhill valleys and on narrow bottom land along the major drainageways. Slopes generally are less than 1 percent but range from 0 to 2 percent.

Loup soils are similar to Tryon soils and are adjacent to Elsmere and Marlake soils. Tryon soils do not have a mollic epipedon. Elsmere soils are somewhat poorly drained and are in the slightly higher positions on the landscape. Marlake soils do not have a mollic epipedon and are stratified. They are very poorly drained and are lower on the landscape than the Loup soils.

Typical pedon of Loup fine sandy loam, 0 to 2 percent slopes, 2,640 feet east and 100 feet south of the northwest corner of sec. 16, T. 24 N., R. 10 W.

A1—0 to 6 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

A2—6 to 13 inches; very dark gray (10YR 3/1) fine sandy loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; hard, friable; neutral; abrupt smooth boundary.

A3—13 to 16 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak medium and fine subangular blocky structure; slightly hard, very friable; neutral; abrupt smooth boundary.

AC—16 to 26 inches; gray (10YR 5/1) fine sand, dark gray (10YR 4/1) moist; few fine prominent brown (7.5YR 5/4 moist) mottles; single grain; loose; neutral; gradual smooth boundary.

C—26 to 35 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; common fine distinct yellowish brown (10YR 5/6 moist) mottles;

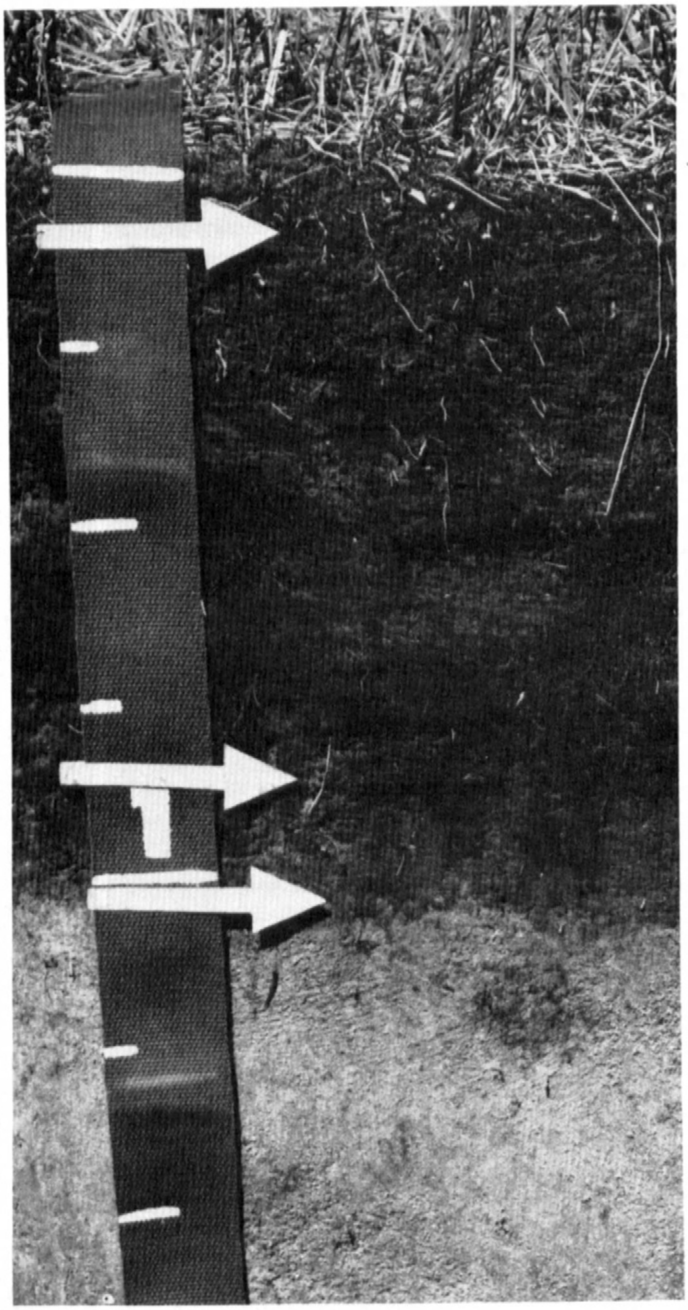

Figure 22.—Profile of Loup fine sandy loam, which formed in sandy alluvium. The upper arrows indicate the surface layer and the lower arrow the bottom of the subsurface layer. Depth is marked in feet.

single grain; loose; neutral; gradual smooth boundary.

Ab—35 to 40 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; common fine prominent strong brown (7.5YR 5/6 moist) mottles; massive; hard, friable; neutral; abrupt wavy boundary.

C'—40 to 60 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; few faint distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; mildly alkaline.

The solum ranges from 10 to 28 inches in thickness. The mollic epipedon ranges from 7 to 20 inches in thickness. Reaction is neutral to moderately alkaline throughout the profile.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It typically is fine sandy loam but in some pedons is loam or loamy fine sand. The AC horizon has value of 4 to 6 (3 to 5 moist) and chroma of 1 or 2. In most pedons it has few or common, fine or medium, faint or distinct, reddish brown, strong brown, or yellowish brown mottles. It is loamy fine sand, loamy sand, fine sand, or sand. The C horizon has value of 6 to 8 (4 to 7 moist) and chroma of 1 or 2. It has few or common, faint or distinct, reddish brown, strong brown, or yellowish brown mottles. It is fine sand or sand.

Marlake Series

The Marlake series consists of deep, very poorly drained, rapidly permeable soils formed in sandy alluvium or in alluvium overlain by sandy eolian material. These soils are in depressions or basins on valley floors. Slopes range from 0 to 2 percent.

Marlake soils are adjacent to Els, Elsmere, Loup, Ord, and Tryon soils. Els, Elsmere, and Ord soils are higher on the landscape than the Marlake soils and are somewhat poorly drained. Loup and Tryon soils are in the slightly higher positions on the landscape. Loup soils have a mollic epipedon. Tryon soils are less stratified than the Marlake soils.

Typical pedon of Marlake loamy fine sand, 0 to 2 percent slopes, 1,900 feet west and 1,700 feet south of the northeast corner of sec. 12, T. 23 N., R. 12 W.

A—0 to 7 inches; dark gray (10YR 4/1) loamy fine sand, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; a layer of partly decayed leaves and stems at the surface; neutral; abrupt smooth boundary.

AC—7 to 22 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; stratified and mixed with dark gray (10YR 4/1) loamy fine sand and light brownish gray (10YR 6/2) fine sand; few fine distinct yellowish brown (10YR 5/6 moist) mottles; weak thick platy structure parting to weak medium and fine granular; slightly hard, very friable; neutral; clear wavy boundary.

C1—22 to 38 inches; light brownish gray (10YR 6/2) fine sand, gray (10YR 5/1) moist; stratified with 1- to 3-

inch layers of dark gray (10YR 4/1) loamy sand; few fine distinct yellowish brown (10YR 5/6 moist) mottles; single grain; loose; neutral; gradual smooth boundary.

C2—38 to 60 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; mildly alkaline.

The solum ranges from 6 to 25 inches in thickness. The mollic colors extend to a depth of 6 to 10 inches. Snail shells are common in some pedons. Reaction is neutral to moderately alkaline throughout the profile.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is commonly loamy fine sand, but the range includes loamy sand and fine sandy loam. The AC and C horizons typically have few or common, faint to prominent, yellowish brown or reddish brown mottles. The AC horizon has value of 3 to 7 (2 to 6 moist) and chroma of 1 to 3. It is dominantly loamy sand or loamy fine sand but is stratified or mixed with coarse sand to silty clay loam. The strata are as much as 3 inches thick. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 1 to 3. It is dominantly sand or fine sand, but strata of finer or coarser textured material are common. Dark buried horizons also are common. In a few pedons accumulations of carbonate are in the upper part of the C horizon.

Nimbro Series

The Nimbro series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in alluvium. Slopes range from 0 to 2 percent.

These soils are not characterized by the fine stratification in the upper part that is definitive for the Nimbro series. Also, they have a slightly thicker dark surface layer. These differences, however, do not affect the usefulness or behavior of the soils.

Nimbro soils are commonly adjacent to Boelus and Loretto soils. The adjacent soils are higher on the landscape than the Nimbro soils. Also, Boelus soils have a less clayey subsoil and Loretto soils a more clayey one. Boelus soils have a sandy surface layer.

Typical pedon of Nimbro silt loam, 0 to 2 percent slopes, 500 feet south and 50 feet west of the northeast corner of sec. 5, T. 24 N., R. 9 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—8 to 20 inches; gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C1—20 to 35 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; common fine distinct yellowish brown (10YR 5/4 moist) mottles; weak medium and fine subangular blocky structure; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

C2—35 to 60 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; brown (10YR 5/3) and pale brown (10YR 6/3) strata; common fine distinct yellowish brown (10YR 5/4 moist) mottles; massive; soft, very friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 20 inches. The mollic colors extend to a depth of 10 to 20 inches. The depth to free carbonates ranges from 0 to 20 inches. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly silt loam, but the range includes loam. The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It has few or common mottles. It is dominantly loam, silt loam, or clay loam. In some pedons, however, it is stratified with sandy loam or loamy fine sand, and in other pedons fine sand is below a depth of 40 inches.

Ord Series

The Ord series consists of deep, somewhat poorly drained soils on bottom land. These soils formed in stratified alluvium. They are moderately rapidly permeable in the upper part and rapidly permeable in the lower part. Slopes range from 0 to 2 percent.

Ord soils are adjacent to Elsmere, Ipage, Loup, and Selia soils. Elsmere and Selia soils are in landscape positions similar to those of the Ord soils. Elsmere soils are more sandy throughout than the Ord soils. Selia soils are strongly affected by alkali. Ipage soils are higher on the landscape than the Ord soils and are moderately well drained. Loup soils are lower on the landscape than the Ord soils and are poorly drained and very poorly drained.

Typical pedon of Ord loam, 0 to 2 percent slopes, 2,300 feet west and 100 feet south of the northeast corner of sec. 11, T. 24 N., R. 10 W.

Apk—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ak—6 to 14 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

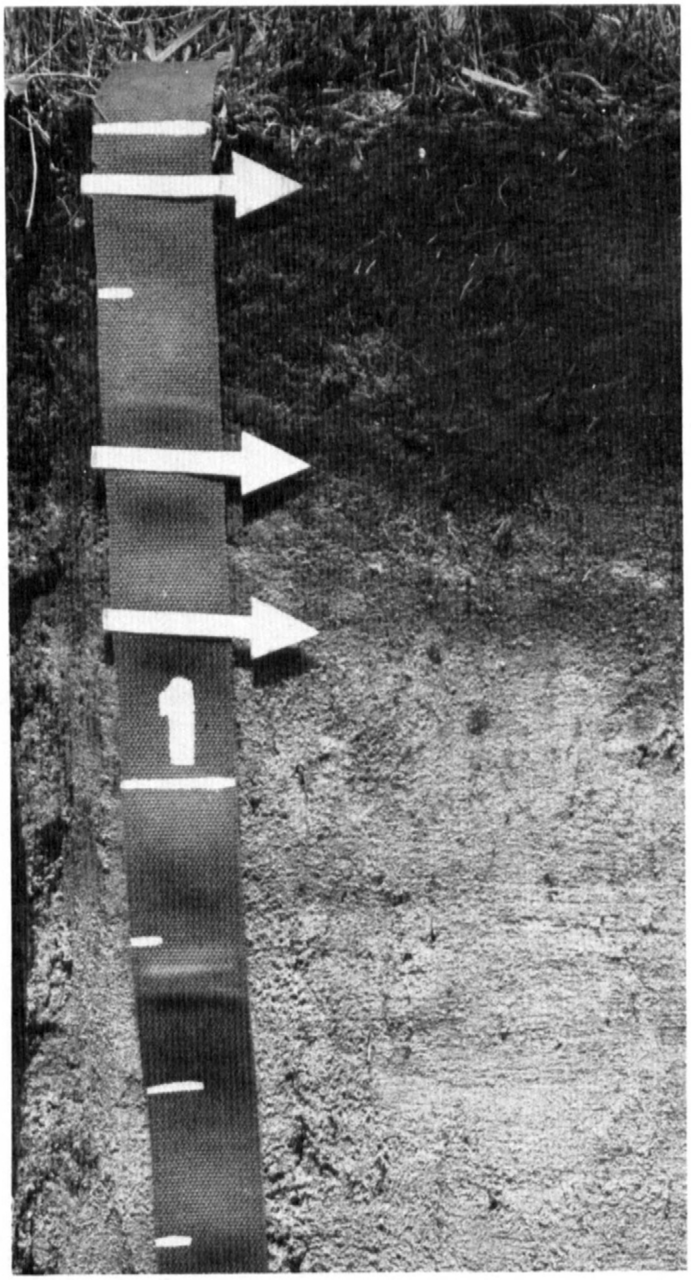

Figure 23.—Profile of Tryon loamy fine sand, which formed in sandy material. The upper arrows indicate the surface layer and the lower arrow the bottom of the transition layer. Depth is marked in feet.

AC—14 to 26 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few fine prominent reddish brown (5YR 5/4 moist) mottles; weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; slightly hard, very friable; mildly alkaline; abrupt smooth boundary.

2C—26 to 60 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; few fine prominent reddish brown (5YR 5/4 moist) mottles; single grain; loose; mildly alkaline.

The thickness of the solum ranges from 20 to 34 inches and commonly is the same as the depth to the underlying fine sand. The mollic epipedon ranges from 10 to 20 inches in thickness. Carbonates are at or near the surface.

The Ak horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1. It is loam or fine sandy loam. It is 10 to 20 inches thick. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 1 or 2. It has mottles in some pedons. It is dominantly fine sandy loam, but in some pedons it has thin strata of loamy fine sand. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2. It is dominantly fine sand, but in some pedons it has strata of finer or coarser textured sediments.

Selia Series

The Selia series consists of deep, somewhat poorly drained soils formed in sandy alluvium on bottom land. These soils are slowly permeable in the solum and moderately rapidly permeable in the underlying material. They have a high content of exchangeable sodium. Slopes range from 0 to 2 percent.

Selia soils are commonly adjacent to Elsmere, Ipage, Loup, and Ord soils. Elsmere and Ord soils are in landscape positions similar to those of the Selia soils. They do not have a high content of sodium and have a mollic epipedon. Ipage soils are higher on the landscape than the Selia soils and are moderately well drained. Loup soils are lower on the landscape than the Selia soils and are poorly drained and very poorly drained.

Typical pedon of Selia loamy fine sand, in an area of Elsmere-Selia loamy fine sands, 0 to 2 percent slopes, 700 feet west and 300 feet north of the southeast corner of sec. 9, T. 24 N., R. 10 W.

A—0 to 4 inches; gray (10YR 5/1) loamy fine sand, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, very friable; moderately alkaline; abrupt wavy boundary.

E—4 to 5 inches; light gray (10YR 6/1) fine sand, dark gray (10YR 4/1) moist; single grain; loose; strongly alkaline; abrupt wavy boundary.

Bt1—5 to 12 inches; dark gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) moist; weak coarse columnar structure parting to weak coarse subangular blocky; very hard, friable; violent effervescence; very strongly alkaline; clear wavy boundary.

Bt2—12 to 22 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium and fine granular; slightly hard, friable; strong effervescence; very strongly alkaline; clear wavy boundary.

BC—22 to 28 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; few medium distinct yellowish brown (10YR 5/6 moist) mottles; weak coarse prismatic structure; slightly hard, friable; many medium and fine accumulations of carbonate; strong effervescence; strong alkaline; clear smooth boundary.

C1—28 to 33 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; common medium and fine prominent reddish brown (5YR 5/4 moist) mottles; single grain; loose; many medium and fine accumulations of carbonate; strong effervescence; strongly alkaline; clear smooth boundary.

C2—33 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; common medium and fine prominent reddish brown (5YR 5/4 moist) mottles; single grain; loose; moderately alkaline.

The solum ranges from 15 to 32 inches in thickness. Carbonates typically are below the A horizon, but in some pedons they are at the surface. Reaction is neutral to strongly alkaline in the A horizon, neutral to very strongly alkaline in the E horizon, strongly alkaline or very strongly alkaline in the Bt horizon, and neutral to very strongly alkaline in the C horizon.

The A and E horizons are fine sand, loamy sand, or loamy fine sand. The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. Some pedons do not have an A horizon. The E horizon has value of 5 to 8 (4 to 7 moist). The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 to 3. It is loamy sand or loamy fine sand. The content of exchangeable sodium in this horizon is more than 15 percent. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It has few to many, faint or distinct, yellowish brown, reddish brown, or brown mottles. It is dominantly sand, fine sand, loamy sand, or loamy fine sand. In some pedons, however, the lower part of this horizon has thin strata of finer or coarser textured material. Loamy material is below a depth of 40 inches in some pedons.

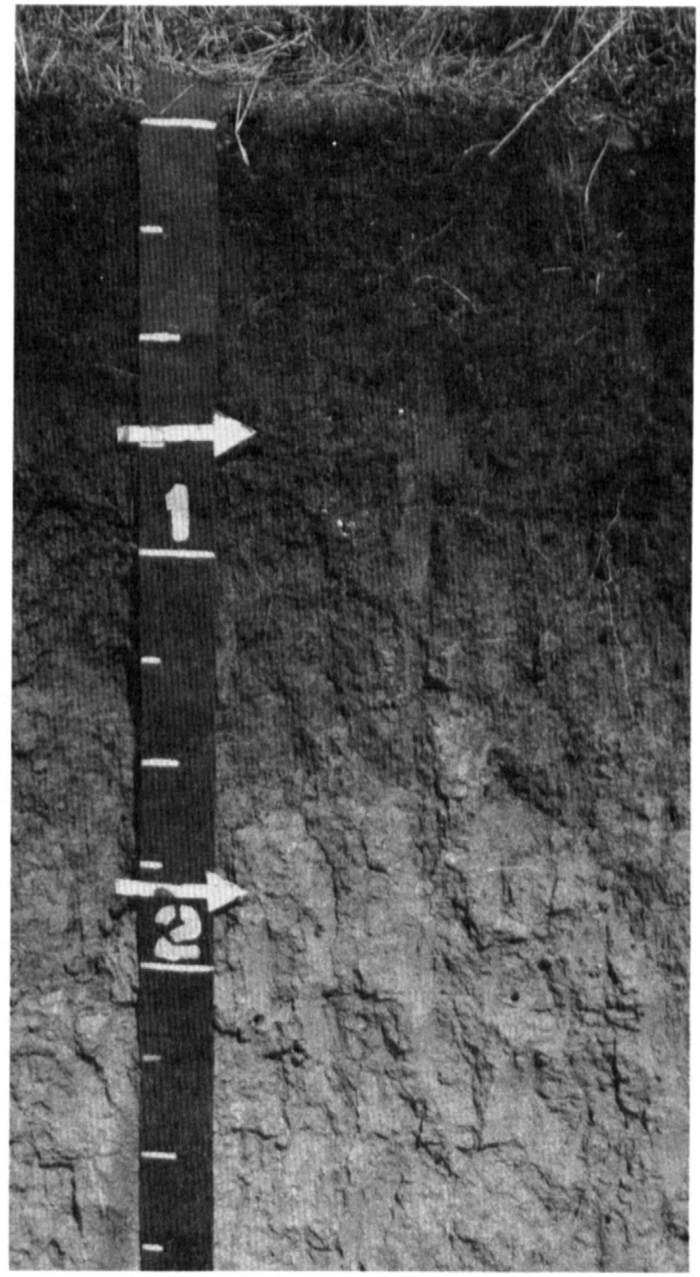

Figure 24.—Profile of Uly silt loam, which formed in loess. The arrows indicate the upper part of the subsoil. Depth is marked in feet.

Tryon Series

The Tryon series consists of deep, poorly drained and very poorly drained, rapidly permeable soils formed in wind- and water-deposited sandy material (fig. 23). These soils are on valley floors, around lakes, and on bottom land along streams in the sandhills. Slopes range from 0 to 2 percent.

Tryon soils are similar to Loup soils and are commonly adjacent to Els, Inavale, Ipage, Marlake, and Valentine soils. Loup soils have a mollic epipedon. Els and Ipage soils are higher on the landscape than the Tryon soils and are better drained. Inavale soils are higher on the landscape than the Tryon soils and are somewhat

excessively drained. Marlake soils are lower on the landscape than the Tryon soils and are wet for longer periods. Valentine soils are on the steeper dunes and are excessively drained.

Typical pedon of Tryon loamy fine sand, 0 to 2 percent slopes, 2,300 feet west and 500 feet south of the northeast corner of sec. 9, T. 23 N., R. 12 W.

A—0 to 7 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

AC—7 to 12 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; few fine prominent reddish brown (5YR 5/4 moist) mottles; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable; neutral; clear smooth boundary.

C1—12 to 24 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; common medium distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; mildly alkaline; gradual smooth boundary.

C2—24 to 60 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; single grain; loose; mildly alkaline.

The solum ranges from 3 to 15 inches in thickness. The mottles in these soils are few to many, fine to coarse, and faint to prominent and are reddish brown, strong brown, or yellowish brown.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is loamy fine sand, fine sand, or loamy sand. It is 3 to 9 inches thick. It ranges from medium acid to moderately alkaline. The AC and C horizons range from medium acid to mildly alkaline. The AC horizon is fine sand or loamy sand. The C horizon has value of 6 to 8 (4 to 7 moist) and chroma of 1 to 3. Some pedons have buried horizons of loamy fine sand at a depth of 10 to 40 inches. These horizons are 1 to 8 inches thick. Thick layers of finer textured material are common below a depth of 40 inches.

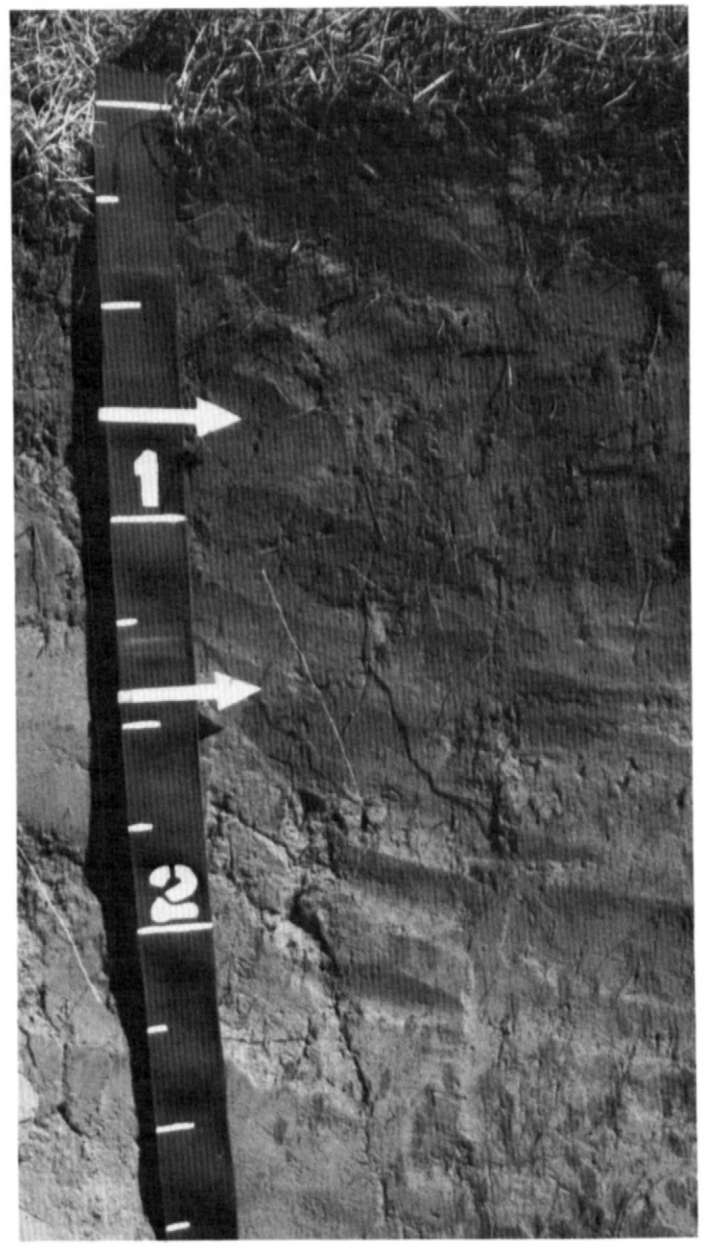

Figure 25.—Profile of Valentine fine sand, which formed in sandy windblown material. The arrows indicate the transition layer. Depth is marked in feet.

Uly Series

The Uly series consists of deep, well drained and somewhat excessively drained, moderately permeable soils on uplands. These soils formed in loess (fig. 24). Slopes range from 3 to 17 percent.

Uly soils are commonly adjacent to Hall and Coly soils. Hall soils have a mollic epipedon that is more than 20 inches thick and have more clay in the subsoil than the Uly soils. They are on the smoother, more nearly level slopes. Coly soils are in the steeper areas. They do not have a mollic epipedon and are shallower to lime than the Uly soils.

Typical pedon of Uly silt loam, 6 to 11 percent slopes, eroded, 1,320 feet north and 100 feet west of the southeast corner of sec. 35, T. 21 N., R. 9 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to weak fine

granular; slightly hard, very friable; slightly acid; abrupt smooth boundary.

Bw1—7 to 11 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; neutral; clear smooth boundary.

Bw2—11 to 21 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; slightly hard, friable; neutral; clear smooth boundary.

BC—21 to 27 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; few soft accumulations of carbonate; violent effervescence; moderately alkaline; gradual smooth boundary.

C—27 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; strong effervescence; many fine white lime accumulations; moderately alkaline.

The solum ranges from 12 to 36 inches in thickness. The mollic epipedon ranges from 7 to 20 inches in thickness. The depth to free carbonates ranges from 8 to 28 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 2. It is dominantly silt loam but in some pedons is very fine sandy loam. The B horizon has value of 4 to 7 (2 to 5 moist) and chroma of 2 or 3. It is silt loam or silty clay loam. The C horizon has value of 4 to 8 (4 to 6 moist) and chroma of 2 to 4. It is dominantly silt loam, but the range includes very fine sandy loam.

The Uly soil in the map unit Coly-Uly silt loams, 11 to 17 percent slopes, eroded, has a dark surface layer that is thinner than is definitive for the Uly series. This difference, however, does not affect the usefulness or behavior of the soil.

Valentine Series

The Valentine series consists of deep, excessively drained, rapidly permeable soils formed in sandy windblown material on uplands (fig. 25). Slopes range from 0 to 60 percent.

Valentine soils are adjacent to Dunday, Els, and Ipage soils. The adjacent soils generally are lower on the landscape than the Valentine soils. Dunday soils have a mollic epipedon. Els soils are somewhat poorly drained. Ipage soils have mottles within a depth of 40 inches.

Typical pedon of Valentine fine sand, rolling, 600 feet east and 2,700 feet north of the southwest corner of sec. 29, T. 24 N., R. 11 W.

A—0 to 5 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; loose; slightly acid; clear smooth boundary.

AC—5 to 12 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; slightly acid; gradual smooth boundary.

C—12 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grain; loose; slightly acid.

The solum ranges from 5 to 17 inches in thickness. The texture is typically fine sand or loamy fine sand throughout the profile, but the range includes sand and loamy sand in which the content of sand is less than 35 percent. Reaction is medium acid or neutral throughout the profile.

The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2. The AC horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 to 4.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated by geologic material. The characteristics of the soil are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material accumulated and has existed since accumulation; (3) the plant and animal life on or in the soil; (4) the relief, or lay of the land; and (5) the length of time that the forces of soil formation have acted on the soil material.

Parent material affects the kind of soil profile that forms more than any of the other factors. Climate and plant and animal life act on the parent material and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. Finally, time is needed for the transformation of the parent material into a soil. Usually, a long time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Parent Material

Parent material is the weathered or partly weathered earthy material in which a soil forms. It affects the chemical and mineralogical composition of the soil. The soils in Wheeler County generally formed in loess, sandy eolian material, and alluvium.

Loess deposits of Illinoian age once mantled most of the county. This material was more than 60 feet thick in the southern part of the county and thinned rapidly to the north. It probably was not more than 15 feet thick along the northern boundary. Throughout most of the county, the loess has been removed or is covered by thick deposits of sandy windblown material. It is still evident in the southeast corner of the county. In areas to the north, it is in a few of the sandhill valleys. It occurs as a thin mantle on uplands in the northeastern part of the county.

The largest area of loess-covered uplands is about 14 square miles in the southeast corner of the county. Because of water erosion, this area is deeply dissected by drainageways. The strongly sloping to very steep Coly soils formed in the Peorian Loess in this area. The gently sloping to moderately steep Uly and very gently sloping Hall soils also formed in loess in this area. Hobbs and Hord soils formed in alluvial material derived mainly from loess. Gates soils formed in loess in the loess-sand transition areas adjacent to the sandhills.

The smaller areas of loess are remnants of the old loess plains. These are small, widely scattered areas in the eastern half of the county and in the southwest corner. In most of these areas, the loess is only a few feet deep over sand or sand and gravel. Many of these areas are in small pockets or swales in the sandhills and are less than 160 acres in size. The largest area is in the northeast corner of the county, along the Holt County line. Uly and Hall soils formed in areas where the loess deposit is at the surface.

Wind-deposited sandy material is the most extensive parent material in the county. About 80 percent of the areas that are not covered by loess are mantled by loose, incoherent sandy material of mixed mineralogy. Quartz and feldspar are the chief minerals. The sandy deposits range from several inches to several hundred feet in thickness. In most areas the wind has sorted out the very fine sand and silt particles and left fine sand in the form of dunes. Valentine soils are the major soils that formed in this material. They show very little evidence of profile development because the sandy material is resistant to weathering and has been in place for a relatively short period. Anselmo, Hersh, and Dunday soils formed in loamy and sandy material in the loess-sand transition areas. Boelus and Libory soils formed in sandy eolian material that overlies loamy and silty sediments.

Alluvium is material deposited by water on bottom land, on terraces in broad stream valleys, or in upland drainageways. It consists of clay, silt, or sand washed from other areas. It ranges from a few feet to more than 20 feet in thickness. The texture varies greatly, depending on the kind of material from which the alluvium was derived and the manner in which it was deposited. The soils on the bottom land along Clearwater Creek, Beaver Creek, and the Cedar River formed mainly in sandy alluvium. Ground water is close to the surface throughout much of this area. The somewhat poorly drained Els and Elsmere soils, the poorly drained and very poorly drained Tryon and Loup soils, and the very poorly drained Marlake soils and Fluvaquents formed in sandy alluvium that is waterlogged at some time during the year.

The somewhat poorly drained Ord and Gibbon soils formed in loamy alluvium or in loamy alluvium over sandy alluvium. The somewhat poorly drained Selia soils formed in loamy and sandy alluvium that is high in content of sodium. The moderately well drained Ipage soils formed in sandy alluvium that has been reworked by the wind. The well drained Libory soils formed in sandy eolian material over loamy alluvial material or loess. Hord and Nimbro soils formed in silty and loamy alluvial material on terraces along Clearwater Creek and the larger tributaries of the Cedar River. Inavale soils formed in stratified, sandy alluvium.

Climate

Wheeler County has a subhumid, continental climate characterized by wide seasonal variations in temperature and precipitation. The mean annual temperature is about 51 degrees F, and the average annual rainfall is about 26 inches. The average growing season is about 155 days.

Rainfall, changes in temperature, and the wind directly affect soil formation. As rainwater penetrates the surface and moves through the soil, it carries nutrients, clay, and organic matter from the surface layer to the subsoil or underlying material. It leaches free lime from the profile. Soil material also is shifted, sorted, and reworked by running water. Temperature and moisture affect the rate of chemical weathering. Alternate cycles of freezing and thawing and of wetting and drying accelerate the chemical and mechanical weathering processes and improve the physical condition of the soil by loosening and mixing the material.

Wind transfers soil material from one place to another. The extensive deposits of sandy eolian material in Wheeler County illustrate the importance of wind as an agent in the deposition of material. The hummocky topography of Valentine soils can be attributed to the wind. The wind mixes and sorts material in the surface layer, causing changes in physical soil properties. Hot wind in the summer has a drying effect on soils.

Climate affects soil formation indirectly through its effect on the amount and kind of vegetation and animal life on and in the soil. Biological activity increases when temperature and moisture conditions are favorable. The decomposition of vegetation results in an accumulation of organic matter and a darkening of the surface layer. This decomposition is brought about by animal and biological activity, which helps to convert plant remains into humus.

Plant and Animal Life

When the weathering and deposition processes slow down, grasses and other plants take root. As soon as vegetation is established, many kinds of animals and other organisms inhabit the soil material, making use of the food provided by the plants. The plants and animals on or in the soil affect physical and chemical soil properties by adding organic matter to the soil. The other soil-forming factors affect the kind and amount of plant and animal life on and in the soil.

The soils in Wheeler County formed under mid and tall grasses. The grasses provide organic matter as the plants and their roots decompose. The fibrous roots of the grasses penetrate the soil to a depth of several feet and improve the porosity and structure of the soil. Plant roots take minerals from the lower part of the soil. These nutrients improve the fertility of the soil as the plants decay. Plants keep the soil porous and open to air and water movement. The improved porosity results in greater activity by bacteria, earthworms, and burrowing animals. Micro-organisms attack dead roots and undecomposed organic matter. The resulting humus and other mineral nutrients are available to living plants.

Some bacteria take nitrogen from the air. When the bacteria die, the nitrogen is available to plants. The activity of micro-organisms and animals increases as the content of organic matter increases in well drained soils. The wetter soils are colder and more poorly aerated. Organic matter decays more slowly in these soils because the living organisms are less numerous. Insects, earthworms, and small burrowing animals mix the soil material with fresh nutrients. This activity hastens the formation of organic matter.

Relief

Relief influences soil formation through its effect on runoff, drainage, and erosion. It controls the movement of water on the surface. The degree of slope, the shape of the surface, and other features of relief affect each soil. Relief influences the moisture content in the soil and the extent of erosion on the surface. Steep soils have a thin surface layer and indistinct horizons. Runoff is rapid on these soils. Only a small amount of water enters the soils. As a result, plants grow slowly and soil formation proceeds slowly. If runoff is excessive, erosion removes the surface layer almost as soon as this layer forms.

Little or no water runs off the surface in the sandhills because of a rapid water intake rate. The excessively drained soils in these areas have indistinct horizons. The sandy material is highly resistant to chemical weathering.

The horizons in nearly level and gently sloping soils generally are more distinct than those in similar soils on steeper slopes. The less sloping soils absorb more moisture and are affected by percolation to a greater depth. Extra moisture is added to nearly level soils in low areas. As a result, these soils have a thick, dark surface layer and have strongly expressed horizons. Also, they are leached of lime to a greater depth than other soils. As the slope increases, the depth of the soil generally decreases. In nearly level areas and in depressions

where little or no water runs off the surface, a claypan may develop in the subsoil.

Soils on bottom land and stream terraces are characterized by very low relief. Some of the soils on bottom land have a seasonal high water table, which affects the decomposition of organic matter, the soil temperature, and the degree of alkalinity. Other soils on bottom land are subject to flooding, which periodically deposits new parent material on the surface.

Time

The length of time needed for a soil to form depends on the effects of the other four soil-forming factors, especially the parent material. Soils that have been in place only a short time show little or no evidence of horizon development. Soils that have been in place a long time have well expressed horizons. Mature soils have reached an equilibrium with their environment. This equilibrium lasts as long as the environment remains unchanged.

The soils in the sandhills and on the bottom land in Wheeler County do not have well expressed horizons. Their parent material has not been in place long enough for a mature soil to form. Also, the sandy parent material in the sandhills is very resistant to weathering and the soils form at a slow rate. The sandy material is not very stable, and soil blowing removes some of the soil material from one place and deposits it in another. When this process takes place, a new cycle of soil formation begins. A new cycle also begins when floodwater on the bottom land deposits new material over older parent material. Valentine and Hobbs are among the youngest soils in Wheeler County.

The loess in the uplands has been in place much longer than the parent material in the sandhills and on the bottom land. As a result, the soils that formed in this silty material are more mature. The loess is less resistant to weathering than the sandy material. Genetic horizons have had time to develop. These include a subsoil that has more clay than the layers above. Hall and Uly are among the oldest, most mature soils in the county.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal unit month. The amount of forage or feed required to carry one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly

continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered

but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic matter content. The amount of organic matter in the soil. The classes of organic matter content used in this survey are very low, less than 0.5 percent; low, 0.5 to 1.0 percent; moderately low, 1.0 to 2.0 percent; moderate, 2.0 to 4.0 percent; and high, 4.0 to 8.0 percent.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Planned grazing system. A system in which two or more units of grazing land are alternately rested and grazed in a planned sequence over a period of years.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. The removal of not more than 50 percent, by weight, of the key management plants when an area of range or pasture is grazed. Proper grazing use protects the surface by maintaining an adequate plant cover. It also maintains or improves the quality and quantity of desirable vegetation.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey area the classes of slope are—

	Percent
Nearly level	0 to 2
Nearly level and very gently sloping	0 to 3
Very gently sloping	1 to 3
Gently sloping	2 to 6
Strongly sloping	6 to 11
Rolling	9 to 24
Moderately steep	11 to 17
Steep	17 to 30
Hilly	24 to 45
Very steep	more than 30

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stratified. Arranged in strata or layers. The term refers to geologic material. Layers in soil that result from the processes of soil formation are called horizons. Those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-80 at York, Nebraska]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	32.4	11.0	21.7	61	-17	0	0.65	0.23	0.98	2	7.6
February---	39.2	17.1	28.2	71	-11	13	.94	.27	1.47	3	6.0
March------	48.4	25.9	37.2	84	-3	38	1.67	.51	2.61	4	6.6
April------	63.7	39.1	51.4	90	19	113	2.87	1.50	4.06	6	1.1
May--------	74.7	50.5	62.6	95	29	397	3.62	1.92	5.10	7	.1
June-------	85.0	60.5	72.8	103	43	684	4.19	1.89	6.15	6	.0
July-------	89.8	65.4	77.6	104	51	856	3.26	1.56	4.72	6	.0
August-----	87.6	63.4	75.5	103	49	791	3.22	1.22	4.88	6	.0
September--	78.3	53.2	65.8	98	33	474	2.74	1.17	4.07	5	.0
October----	67.9	41.5	54.7	90	22	195	1.58	.29	2.57	3	.3
November---	50.5	27.6	39.1	76	5	6	1.06	.13	1.76	2	3.4
December---	38.4	17.5	28.0	68	-10	0	.80	.20	1.28	2	7.9
Yearly:											
Average--	63.0	39.4	51.2	---	---	---	---	---	---	---	---
Extreme--	---	---	---	105	-17	---	---	---	---	---	---
Total----	---	---	---	---	---	3,567	26.60	20.98	31.88	52	33.0

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-80 at York, Nebraska]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 15	Apr. 30	May 10
2 years in 10 later than--	Apr. 11	Apr. 25	May 5
5 years in 10 later than--	Apr. 2	Apr. 15	Apr. 26
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 18	Oct. 8	Sept. 29
2 years in 10 earlier than--	Oct. 23	Oct. 13	Oct. 4
5 years in 10 earlier than--	Nov. 1	Oct. 22	Oct. 12

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-80 at York, Nebraska]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	192	172	147
8 years in 10	199	178	155
5 years in 10	212	189	169
2 years in 10	225	201	184
1 year in 10	232	207	191

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
An	Anselmo fine sandy loam, 0 to 2 percent slopes	430	0.1
AnC	Anselmo fine sandy loam, 2 to 6 percent slopes	770	0.2
Bg	Blownout land-Valentine complex, 6 to 60 percent slopes	6,310	1.7
BsB	Boelus loamy sand, 0 to 3 percent slopes	5,310	1.4
BsC	Boelus loamy sand, 3 to 6 percent slopes	2,370	0.6
CoD2	Coly silt loam, 6 to 11 percent slopes, eroded	250	0.1
CoF	Coly silt loam, 17 to 30 percent slopes	2,140	0.6
CpG	Coly-Hobbs silt loams, 2 to 60 percent slopes	1,650	0.4
CuE2	Coly-Uly silt loams, 11 to 17 percent slopes, eroded	1,340	0.4
DuB	Dunday loamy fine sand, 0 to 3 percent slopes	3,270	0.9
DuC	Dunday loamy fine sand, 3 to 6 percent slopes	12,220	3.3
Eb	Els loamy sand, 0 to 2 percent slopes	7,290	2.0
EfB	Els-Ipage fine sands, 0 to 3 percent slopes	25,870	7.0
Em	Elsmere loamy fine sand, 0 to 2 percent slopes	8,600	2.3
EnB	Elsmere-Ipage loamy fine sands, 0 to 3 percent slopes	7,420	2.0
Ep	Elsmere-Loup complex, 0 to 2 percent slopes	12,180	3.3
Eu	Elsmere-Selia loamy fine sands, 0 to 2 percent slopes	220	0.1
Fu	Fluvaquents, sandy	1,190	0.3
GfB	Gates very fine sandy loam, 0 to 3 percent slopes	600	0.2
GfC	Gates very fine sandy loam, 3 to 6 percent slopes	670	0.2
GfD	Gates very fine sandy loam, 6 to 11 percent slopes	880	0.2
Gk	Gibbon loam, 0 to 2 percent slopes	140	*
HaB	Hall silt loam, 1 to 3 percent slopes	230	0.1
HeB	Hersh fine sandy loam, 0 to 3 percent slopes	900	0.2
Hk	Hobbs silt loam, 0 to 2 percent slopes	810	0.2
HtB	Hord silt loam, terrace, 1 to 3 percent slopes	220	0.1
IfB	Ipage fine sand, 0 to 3 percent slopes	5,270	1.4
IgB	Ipage loamy sand, 0 to 3 percent slopes	5,420	1.5
LfB	Libory loamy fine sand, 0 to 3 percent slopes	660	0.2
Ln	Loretto loam, 0 to 2 percent slopes	1,780	0.5
Lo	Loup fine sandy loam, 0 to 2 percent slopes	12,730	3.5
Lr	Loup fine sandy loam, wet, 0 to 2 percent slopes	4,200	1.1
Ma	Marlake loamy fine sand, 0 to 2 percent slopes	740	0.2
Nb	Nimbro silt loam, 0 to 2 percent slopes	100	*
Or	Ord loam, 0 to 2 percent slopes	520	0.1
Tn	Tryon loamy fine sand, 0 to 2 percent slopes	2,950	0.8
Tp	Tryon loamy fine sand, wet, 0 to 2 percent slopes	1,220	0.3
Ts	Tryon-Inavale complex, channeled	1,530	0.4
UbC	Uly silt loam, 3 to 6 percent slopes	530	0.1
UbD2	Uly silt loam, 6 to 11 percent slopes, eroded	1,180	0.3
VaB	Valentine fine sand, 0 to 3 percent slopes	1,180	0.3
VaD	Valentine fine sand, 3 to 9 percent slopes	21,700	6.0
VaE	Valentine fine sand, rolling	86,274	23.6
VaF	Valentine fine sand, rolling and hilly	70,700	19.3
VeB	Valentine loamy fine sand, 0 to 3 percent slopes	920	0.2
VfD	Valentine-Dunday loamy fine sands, 3 to 9 percent slopes	21,500	5.8
VmD	Valentine-Els fine sands, 0 to 9 percent slopes	23,040	6.4
	Water areas greater than 40 acres in size	109	*
	Water areas less than 40 acres in size	531	0.1
	Total	368,064	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
An	Anselmo fine sandy loam, 0 to 2 percent slopes
AnC	Anselmo fine sandy loam, 2 to 6 percent slopes
GfB	Gates very fine sandy loam, 0 to 3 percent slopes
GfC	Gates very fine sandy loam, 3 to 6 percent slopes
Gk	Gibbon loam, 0 to 2 percent slopes (where drained)*
HaB	Hall silt loam, 1 to 3 percent slopes
HeB	Hersh fine sandy loam, 0 to 3 percent slopes
Hk	Hobbs silt loam, 0 to 2 percent slopes
HtB	Hord silt loam, terrace, 1 to 3 percent slopes
Ln	Loretto loam, 0 to 2 percent slopes
Nb	Nimbro silt loam, 0 to 2 percent slopes
Or	Ord loam, 0 to 2 percent slopes (where drained)*
UbC	Uly silt loam, 3 to 6 percent slopes

* These soils generally have been adequately drained either by the application of drainage measures or through the incidental drainage that results from farming, road building, and other kinds of land development.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability		Corn		Grain sorghum		Alfalfa hay	
	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Tons	Tons
An Anselmo	IIe	IIe	48	142	56	120	2.2	5.2
AnC Anselmo	IIIe	IIIe	42	125	38	100	2.0	5.0
Bg* Blowout land-Valentine	VIIe	---	---	---	---	---	---	---
BsB Boelus	IIIe	IIIe	40	140	50	110	3.0	5.2
BsC Boelus	IVe	IIIe	36	132	45	90	2.8	4.9
CoD2 Coly	IVe	IVe	27	100	24	65	1.2	3.7
CoF Coly	VIe	---	---	---	---	---	---	---
CpG Coly-Hobbs	VIIe	---	---	---	---	---	---	---
CuE2 Coly-Uly	VIe	---	---	---	---	---	---	---
DuB Dunday	IVe	IIIe	37	135	48	90	1.4	4.4
DuC Dunday	IVe	IVe	32	124	40	80	1.2	4.0
Eb Els	IVw	IVw	31	120	38	80	2.0	4.2
EfB Els-Ipage	VIe	IVe	---	115	---	60	---	3.9
Em Elsmere	IVw	IVw	40	120	41	82	2.5	4.2
EnB Elsmere-Ipage	IVe	IVe	38	125	42	85	1.8	4.3
Ep Elsmere-Loup	Vw	---	---	---	---	---	---	---
Eu Elsmere-Selia	VIs	IVs	---	105	---	62	---	---
Fu Fluvaquents	VIIIw	---	---	---	---	---	---	---
GfB Gates	IIe	IIe	44	135	50	110	3.4	5.5

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Grain sorghum		Alfalfa hay	
	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Tons	Tons
GfC----------------------- Gates	IIIe	IIIe	39	125	45	100	2.4	5.0
GfD----------------------- Gates	IVe	IVe	27	115	30	85	1.7	4.0
Gk----------------------- Gibbon	IIw	IIw	67	140	72	120	4.2	5.9
HaB----------------------- Hall	IIe	IIe	52	145	58	118	2.4	5.5
HeB----------------------- Hersh	IIIe	IIe	40	125	45	100	2.0	4.6
Hk----------------------- Hobbs	IIw	IIw	62	140	70	120	4.2	6.2
HtB----------------------- Hord	IIe	IIe	57	150	58	125	3.7	6.2
IfB----------------------- Ipage	VIe	IVe	---	120	---	65	---	4.0
IgB----------------------- Ipage	IVe	IVe	32	130	35	86	1.2	4.5
LfB----------------------- Libory	IIIe	IIIe	45	135	52	112	3.4	5.2
Ln----------------------- Loretto	IIc	I	54	145	60	120	2.5	5.7
Lo, Lr------------------- Loup	Vw	---	---	---	---	---	---	---
Ma----------------------- Marlake	VIIIw	---	---	---	---	---	---	---
Nb----------------------- Nimbro	IIc	I	55	150	60	120	2.6	5.8
Or----------------------- Ord	IIw	IIw	48	130	55	115	2.6	5.0
Tn, Tp------------------- Tryon	Vw	---	---	---	---	---	---	---
Ts----------------------- Tryon-Inavale	VIw	---	---	---	---	---	---	---
UbC----------------------- Uly	IIIe	IIIe	44	130	48	100	2.2	5.2
UbD2---------------------- Uly	IVe	IVe	30	110	32	70	1.5	4.4
VaB----------------------- Valentine	VIe	IVe	---	110	---	60	---	3.5

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Grain sorghum		Alfalfa hay	
	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Tons	Tons
VaD: Valentine	VIe	IVe	---	100	---	55	---	3.3
VaE: Valentine	VIe	---	---	---	---	---	---	---
VaF: Valentine	VIIe	---	---	---	---	---	---	---
VeB: Valentine	IVe	IVe	30	125	33	75	1.4	4.0
VfD: Valentine-Dunday	VIe	IVe	---	120	---	72	---	3.5
VmD: Valentine-Els	VIe	IVe	---	105	---	---	---	3.2

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (N)	---	---	---	---	---
(I)	1,880	---	---	---	---
II (N)	4,830	1,480	1,470	---	1,880
(I)	3,850	2,380	1,470	---	---
III (N)	8,840	8,840	---	---	---
(I)	13,580	13,580	---	---	---
IV (N)	42,400	26,510	15,890	---	---
(I)	142,960	126,850	15,890	220	---
V (N)	33,280	---	33,280	---	---
VI (N)	197,484	195,734	1,530	220	---
VII (N)	78,660	78,660	---	---	---
VIII (N)	1,930	---	1,930	---	---

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
An, AnC: Anselmo	Sandy	Favorable	3,500	Little bluestem	25
		Normal	3,300	Sand bluestem	15
		Unfavorable	3,000	Prairie sandreed	15
				Needleandthread	15
				Blue grama	10
				Switchgrass	5
				Western wheatgrass	5
Bg*: Blownout land.					
Valentine	Sands	Favorable	2,800	Sand bluestem	25
		Normal	2,400	Little bluestem	20
		Unfavorable	2,000	Prairie sandreed	15
				Needleandthread	10
				Switchgrass	5
				Sand lovegrass	5
				Blue grama	5
BsB, BsC: Boelus	Sandy	Favorable	3,500	Little bluestem	20
		Normal	3,300	Prairie sandreed	20
		Unfavorable	3,000	Needleandthread	15
				Blue grama	10
				Sand bluestem	5
CoD2, CoF: Coly	Limy Upland	Favorable	3,300	Little bluestem	30
		Normal	3,000	Big bluestem	20
		Unfavorable	2,700	Sideoats grama	10
				Blue grama	5
				Indiangrass	5
CpG*: Coly	Thin Loess	Favorable	2,800	Little bluestem	35
		Normal	2,600	Big bluestem	20
		Unfavorable	2,400	Sideoats grama	10
				Plains muhly	5
				Blue grama	5
Hobbs	Silty Overflow	Favorable	4,500	Big bluestem	30
		Normal	4,200	Western wheatgrass	20
		Unfavorable	3,800	Little bluestem	15
				Switchgrass	10
				Sideoats grama	5
				Sedge	5
CuE2*: Coly	Limy Upland	Favorable	3,300	Little bluestem	30
		Normal	3,000	Big bluestem	20
		Unfavorable	2,700	Sideoats grama	10
				Western wheatgrass	10
				Blue grama	5
				Indiangrass	5
Uly	Silty	Favorable	3,700	Big bluestem	25
		Normal	3,200	Little bluestem	25
		Unfavorable	2,700	Sideoats grama	10
				Blue grama	10
				Western wheatgrass	10
				Sedge	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
DuB, DuC: Dunday	Sandy	Favorable	3,300	Sand bluestem	25
		Normal	3,000	Little bluestem	20
		Unfavorable	2,600	Prairie sandreed	15
				Needleandthread	10
				Blue grama	10
				Switchgrass	5
				Sedge	5
Eb: Els	Subirrigated	Favorable	5,500	Big bluestem	35
		Normal	5,300	Little bluestem	25
		Unfavorable	5,000	Indiangrass	15
				Switchgrass	10
				Prairie cordgrass	5
				Sedge	5
EfB*:					
Els	Subirrigated	Favorable	5,500	Big bluestem	35
		Normal	5,300	Little bluestem	25
		Unfavorable	5,000	Indiangrass	15
				Switchgrass	10
				Prairie cordgrass	5
				Sedge	5
Ipage	Sandy Lowland	Favorable	3,500	Sand bluestem	15
		Normal	3,200	Prairie sandreed	15
		Unfavorable	3,000	Little bluestem	10
				Needleandthread	10
				Kentucky bluegrass	5
				Indiangrass	5
				Prairie junegrass	5
				Sedge	5
				Switchgrass	5
				Blue grama	5
				Scribner panicum	5
				Leadplant	5
Em: Elsmere	Subirrigated	Favorable	5,500	Big bluestem	35
		Normal	5,300	Little bluestem	20
		Unfavorable	5,000	Indiangrass	10
				Switchgrass	5
				Prairie cordgrass	5
EnB*:					
Elsmere	Subirrigated	Favorable	5,500	Big bluestem	35
		Normal	5,300	Little bluestem	20
		Unfavorable	5,000	Indiangrass	10
				Switchgrass	5
				Prairie cordgrass	5
Ipage	Sandy Lowland	Favorable	3,500	Sand bluestem	15
		Normal	3,200	Prairie sandreed	15
		Unfavorable	3,000	Little bluestem	10
				Needleandthread	10
				Kentucky bluegrass	5
				Indiangrass	5
				Prairie junegrass	5
				Sedge	5
				Switchgrass	5
				Blue grama	5
				Scribner panicum	5
				Leadplant	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ep*:					
Elsmere	Subirrigated	Favorable	5,500	Big bluestem	35
		Normal	5,300	Little bluestem	20
		Unfavorable	5,000	Indiangrass	10
				Switchgrass	5
				Prairie cordgrass	5
Loup	Wet Subirrigated	Favorable	5,800	Switchgrass	25
		Normal	5,500	Indiangrass	15
		Unfavorable	5,300	Prairie cordgrass	15
				Big bluestem	15
				Plains bluegrass	5
				Northern reedgrass	5
Eu*:					
Elsmere	Subirrigated	Favorable	5,500	Big bluestem	35
		Normal	5,300	Little bluestem	20
		Unfavorable	5,000	Indiangrass	10
				Switchgrass	5
				Prairie cordgrass	5
Selia	Saline Subirrigated	Favorable	3,800	Alkali sacaton	25
		Normal	3,400	Inland saltgrass	10
		Unfavorable	3,000	Western wheatgrass	10
				Switchgrass	10
				Slender wheatgrass	10
				Foxtail barley	5
				Plains bluegrass	5
GfB, GfC, GfD Gates	Silty	Favorable	3,700	Big bluestem	30
		Normal	3,200	Little bluestem	15
		Unfavorable	2,700	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
				Blue grama	5
				Needleandthread	5
				Sedge	5
				Leadplant	5
Gk Gibbon	Subirrigated	Favorable	5,500	Big bluestem	25
		Normal	5,300	Little bluestem	15
		Unfavorable	5,000	Indiangrass	15
				Switchgrass	10
				Prairie cordgrass	10
				Sedge	10
				Kentucky bluegrass	5
HaB Hall	Silty	Favorable	4,000	Little bluestem	25
		Normal	3,600	Big bluestem	20
		Unfavorable	3,300	Western wheatgrass	15
				Blue grama	10
				Sideoats grama	10
				Switchgrass	5
				Sedge	5
HeB Hersh	Sandy	Favorable	3,500	Sand bluestem	30
		Normal	3,300	Little bluestem	25
		Unfavorable	3,000	Prairie sandreed	15
				Needleandthread	10
				Blue grama	5
				Switchgrass	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Hk: Hobbs	Silty Overflow	Favorable	4,500	Big bluestem	30
		Normal	4,300	Western wheatgrass	20
		Unfavorable	3,800	Little bluestem	15
				Switchgrass	10
				Sideoats grama	5
				Sedge	5
HtB: Hord	Silty Lowland	Favorable	4,500	Big bluestem	30
		Normal	4,200	Little bluestem	20
		Unfavorable	3,800	Switchgrass	10
				Western wheatgrass	10
				Sideoats grama	5
				Blue grama	5
IfB, IgB: Ipage	Sandy Lowland	Favorable	3,500	Sand bluestem	15
		Normal	3,200	Prairie sandreed	15
		Unfavorable	3,000	Little bluestem	10
				Needleandthread	10
				Kentucky bluegrass	5
				Indiangrass	5
				Prairie junegrass	5
				Sedge	5
				Switchgrass	5
				Blue grama	5
				Scribner panicum	5
				Leadplant	5
LfB: Libory	Sandy Lowland	Favorable	3,500	Big bluestem	35
		Normal	3,200	Little bluestem	15
		Unfavorable	3,000	Switchgrass	15
				Indiangrass	10
				Sedge	5
Ln: Loretto	Silty	Favorable	3,700	Big bluestem	20
		Normal	3,200	Little bluestem	20
		Unfavorable	2,700	Indiangrass	10
				Switchgrass	10
				Sideoats grama	10
				Porcupinegrass	5
				Blue grama	5
				Sedge	5
				Western wheatgrass	5
Lo: Loup	Wet Subirrigated	Favorable	5,800	Switchgrass	25
		Normal	5,500	Indiangrass	15
		Unfavorable	5,300	Prairie cordgrass	15
				Big bluestem	15
				Plains bluegrass	5
				Northern reedgrass	5
Lr: Loup	Wetland	Favorable	6,000	Prairie cordgrass	30
		Normal	5,800	Northern reedgrass	20
		Unfavorable	5,500	Bluejoint reedgrass	20
				Sedge	10
				Rush	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Compo-sition
		Kind of year	Dry weight		
			Lb/acre		Pct
Nb: Nimbro	Silty Lowland	Favorable	4,500	Big bluestem	30
		Normal	4,200	Little bluestem	20
		Unfavorable	3,800	Western wheatgrass	10
				Switchgrass	10
				Sideoats grama	10
				Sedge	5
				Indiangrass	5
Or: Ord	Subirrigated	Favorable	5,500	Big bluestem	30
		Normal	5,300	Little bluestem	15
		Unfavorable	5,000	Indiangrass	15
				Switchgrass	10
				Prairie cordgrass	10
				Plains bluegrass	5
Tn: Tryon	Wet Subirrigated	Favorable	5,800	Switchgrass	20
		Normal	5,500	Indiangrass	15
		Unfavorable	5,300	Big bluestem	15
				Prairie cordgrass	10
				Slender wheatgrass	5
				Plains bluegrass	5
Tp: Tryon	Wetland	Favorable	6,000	Prairie cordgrass	25
		Normal	5,800	Northern reedgrass	20
		Unfavorable	5,500	Bluejoint reedgrass	15
				Rush	5
				Slender wheatgrass	5
Ts*:					
Tryon	Wet Subirrigated	Favorable	5,800	Switchgrass	20
		Normal	5,500	Indiangrass	15
		Unfavorable	5,300	Big bluestem	15
				Prairie cordgrass	10
				Slender wheatgrass	5
				Plains bluegrass	5
Inavale	Sandy Lowland	Favorable	3,500	Sand bluestem	45
		Normal	3,000	Porcupinegrass	10
		Unfavorable	2,000	Little bluestem	10
				Prairie sandreed	10
				Switchgrass	5
				Needleandthread	5
				Sedge	5
UbC, UbD2: Uly	Silty	Favorable	3,700	Big bluestem	25
		Normal	3,200	Little bluestem	25
		Unfavorable	2,700	Sideoats grama	10
				Blue grama	10
				Western wheatgrass	10
				Sedge	5
VaB: Valentine	Sandy	Favorable	3,300	Little bluestem	20
		Normal	3,000	Sand bluestem	15
		Unfavorable	2,600	Prairie sandreed	15
				Needleandthread	15
				Blue grama	10
				Switchgrass	5
				Sand dropseed	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
VaD, VaE: Valentine	Sands	Favorable	3,000	Sand bluestem	25
		Normal	2,600	Little bluestem	20
		Unfavorable	2,200	Prairie sandreed	15
				Needleandthread	10
				Switchgrass	5
				Sand lovegrass	5
				Blue grama	5
VaF*:					
Valentine, rolling	Sands	Favorable	3,000	Sand bluestem	25
		Normal	2,600	Little bluestem	20
		Unfavorable	2,200	Prairie sandreed	15
				Needleandthread	10
				Switchgrass	5
				Sand lovegrass	5
				Blue grama	5
Valentine, hilly	Choppy Sands	Favorable	2,800	Prairie sandreed	20
		Normal	2,400	Sand bluestem	15
		Unfavorable	2,000	Little bluestem	15
				Switchgrass	10
				Needleandthread	10
				Sand lovegrass	5
				Blue grama	5
				Sandhill muhly	5
VeB: Valentine	Sandy	Favorable	3,300	Little bluestem	20
		Normal	3,000	Sand bluestem	15
		Unfavorable	2,600	Prairie sandreed	15
				Needleandthread	15
				Blue grama	10
				Switchgrass	5
				Sand dropseed	5
VfD*:					
Valentine	Sands	Favorable	3,100	Sand bluestem	25
		Normal	2,700	Little bluestem	20
		Unfavorable	2,300	Prairie sandreed	15
				Needleandthread	10
				Switchgrass	5
				Sand lovegrass	5
				Blue grama	5
Dunday	Sandy	Favorable	3,300	Sand bluestem	25
		Normal	3,000	Little bluestem	20
		Unfavorable	2,600	Prairie sandreed	15
				Needleandthread	10
				Blue grama	10
				Switchgrass	5
				Sedge	5
VmD*:					
Valentine	Sands	Favorable	3,000	Sand bluestem	25
		Normal	2,600	Little bluestem	20
		Unfavorable	2,200	Prairie sandreed	15
				Needleandthread	10
				Switchgrass	5
				Sand lovegrass	5
				Blue grama	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Compo-sition
		Kind of year	Dry weight		
			Lb/acre		Pct
VmD*:					
Els	Subirrigated	Favorable	5,500	Big bluestem	35
		Normal	5,300	Little bluestem	25
		Unfavorable	5,000	Indiangrass	15
				Switchgrass	10
				Prairie cordgrass	5
				Sedge	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
An, AnC: Anselmo	Lilac, American plum.	Common chokecherry	Eastern redcedar, Austrian pine, ponderosa pine, Scotch pine, honeylocust, green ash, hackberry, Russian mulberry.	Siberian elm	---
Bg*: Blownout land.					
Valentine.					
BsB, BsC: Boelus	Lilac, skunkbush sumac, Tatarian honeysuckle.	Siberian peashrub, Manchurian crabapple, eastern redcedar, Russian-olive.	Green ash, ponderosa pine, hackberry, honeylocust.	Siberian elm	---
CoD2: Coly	Silver buffaloberry, fragrant sumac, Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, bur oak, Russian-olive.	Green ash, ponderosa pine, honeylocust, Siberian elm.	---	---
CoF. Coly					
CpG*: Coly.					
Hobbs.					
CuE2*: Coly	Silver buffaloberry, fragrant sumac, Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, bur oak, Russian-olive.	Green ash, ponderosa pine, honeylocust, Siberian elm.	---	---
Uly	Amur honeysuckle, lilac.	Common chokecherry, Russian mulberry.	Eastern redcedar, green ash, Russian-olive, honeylocust, Austrian pine, hackberry, bur oak.	Siberian elm	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
DuB, DuC: Dunday	Skunkbush sumac, Tatarian honeysuckle, lilac.	Eastern redcedar, Manchurian crabapple, Russian-olive, Siberian peashrub.	Ponderosa pine, green ash, hackberry, honeylocust.	Siberian elm	---
Eb: Els	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
EfB*:					
Els	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
Ipage	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
Em: Elsmere	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
EnB*:					
Elsmere	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
Ipage	Tatarian honeysuckle, lilac, skunkbush sumac.	Eastern redcedar, Manchurian crabapple, Russian-olive, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm	---
Ep*:					
Elsmere	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine, Manchurian crab-apple.	Honeylocust, golden willow.	Eastern cottonwood.
Loup	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Eu*: Elsmere	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine, Manchurian crab-apple.	Honeylocust, golden willow.	Eastern cottonwood.
Selia.					
Fu. Fluvaquents					
GfB, GfC, GfD Gates	Amur honeysuckle, fragrant sumac, lilac.	Russian mulberry	Green ash, honeylocust, Russian-olive, eastern redcedar, bur oak, hack-berry, ponderosa pine.	Siberian elm	---
Gk Gibbon	Lilac	Common chokecherry, Tatarian honey-suckle, Siberian peashrub.	Eastern redcedar, hackberry, ponderosa pine, green ash, Manchurian crabapple.	Honeylocust, golden willow.	Eastern cottonwood.
HaB Hall	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian-olive.	Siberian elm	---
HeB Hersh	Lilac, American plum.	Common chokecherry	Eastern redcedar, honeylocust, hackberry, ponderosa pine, green ash, Russian mulberry, Scotch pine, Austrian pine.	Siberian elm	---
Hk Hobbs	American plum	Amur honeysuckle, lilac, Siberian peashrub.	Eastern redcedar, Austrian pine, ponderosa pine, green ash, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
HtB Hord	Peking cotoneaster	Lilac, Siberian peashrub, American plum.	Eastern redcedar, ponderosa pine, blue spruce, Manchurian crabapple.	Golden willow, green ash, hackberry.	Eastern cottonwood.
IfB Ipage	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
IgB Ipage	Tatarian honeysuckle, lilac, skunkbush sumac.	Eastern redcedar, Manchurian crabapple, Russian-olive, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm	---
LfB Libory	Tatarian honeysuckle, lilac, skunkbush sumac.	Eastern redcedar, Russian-olive, Manchurian crabapple, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm	---
Ln Loretto	---	American plum, Tatarian honeysuckle, lilac, Siberian peashrub.	Eastern redcedar, blue spruce, bur oak, Russian-olive, hackberry.	Honeylocust, green ash, ponderosa pine.	---
Lo Loup	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Lr. Loup					
Ma. Marlake					
Nb Nimbro	Lilac	Tatarian honeysuckle, Siberian peashrub, American plum.	Ponderosa pine, green ash, hackberry, Russian mulberry, eastern redcedar, bur oak.	Honeylocust	Eastern cottonwood.
Or Ord	American plum	Common chokecherry, Tatarian honeysuckle.	Eastern redcedar, Austrian pine, Russian mulberry, green ash, hackberry, ponderosa pine, Manchurian crabapple.	Honeylocust, golden willow.	Eastern cottonwood.
Tn Tryon	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Tp. Tryon					
Ts*: Tryon.					
Inavale.					

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
UbC, UbD2--------- Uly	Amur honeysuckle, lilac.	Common chokecherry, Russian mulberry.	Eastern redcedar, green ash, Russian-olive, honeylocust, Austrian pine, hackberry, bur oak.	Siberian elm------	---
VaB, VaD, VaE----- Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
VaF*: Valentine, rolling.					
Valentine, hilly.					
VeB--------------- Valentine	Lilac, Tatarian honeysuckle, skunkbush sumac.	Eastern redcedar, Russian-olive, Manchurian crabapple, Siberian peashrub.	Hackberry, ponderosa pine, green ash, honeylocust.	Siberian elm------	---
VfD*: Valentine--------	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
Dunday-----------	Skunkbush sumac, Tatarian honeysuckle, lilac.	Eastern redcedar, Rocky Mountain juniper, Russian-olive, Siberian peashrub.	Austrian pine, green ash, hackberry, honeylocust.	Siberian elm------	---
VmD*: Valentine--------	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
Els--------------	Lilac-------------	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
An-------------------- Anselmo	Slight---------------	Slight---------------	Slight---------------	Slight.
AnC------------------- Anselmo	Slight---------------	Slight---------------	Moderate: slope.	Slight.
Bg*: Blownout land.				
Valentine------------	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
BsB------------------- Boelus	Slight---------------	Slight---------------	Slight---------------	Slight.
BsC------------------- Boelus	Slight---------------	Slight---------------	Moderate: slope.	Slight.
CoD2------------------ Coly	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
CoF------------------- Coly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
CpG*:				
Coly-----------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Hobbs----------------	Severe: flooding.	Slight---------------	Moderate: slope, flooding.	Slight.
CuE2*:				
Coly-----------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Uly------------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
DuB------------------- Dunday	Slight---------------	Slight---------------	Slight---------------	Slight.
DuC------------------- Dunday	Slight---------------	Slight---------------	Moderate: slope.	Slight.
Eb-------------------- Els	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
EfB*:				
Els------------------	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Ipage----------------	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Em Elsmere	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
EnB*:				
Elsmere	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
Ipage	Slight	Slight	Slight	Slight.
Ep*:				
Elsmere	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
Loup	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Eu*:				
Elsmere	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
Selia	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: wetness.
Fu. Fluvaquents				
GfB Gates	Slight	Slight	Slight	Severe: erodes easily.
GfC Gates	Slight	Slight	Moderate: slope.	Severe: erodes easily.
GfD Gates	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Gk Gibbon	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.
HaB Hall	Slight	Slight	Moderate: slope.	Slight.
HeB Hersh	Slight	Slight	Slight	Slight.
Hk Hobbs	Severe: flooding.	Slight	Moderate: flooding.	Slight.
HtB Hord	Severe: flooding.	Slight	Moderate: slope.	Slight.
IfB Ipage	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
IgB Ipage	Slight	Slight	Slight	Slight.
LfB Libory	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ln: Loretto	Slight	Slight	Slight	Slight.
Lo: Loup	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Lr: Loup	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Ma: Marlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Nb: Nimbro	Slight	Slight	Slight	Slight.
Or: Ord	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
Tn: Tryon	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Tp: Tryon	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Ts*:				
Tryon	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.
Inavale	Severe: flooding.	Slight	Slight	Slight.
UbC: Uly	Slight	Slight	Moderate: slope.	Slight.
UbD2: Uly	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
VaB: Valentine	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
VaD, VaE: Valentine	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
VaF*:				
Valentine, rolling	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Valentine, hilly	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
VeB: Valentine	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
VfD*:				
Valentine	Slight	Slight	Severe: slope.	Slight.
Dunday	Slight	Slight	Severe: slope.	Slight.
VmD*:				
Valentine	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Els	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
An: Anselmo	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
AnC: Anselmo	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Bg*: Blownout land.												
Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
BsB, BsC: Boelus	Fair	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
CoD2: Coly	Fair	Good	Good	Good	Fair	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
CoF: Coly	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
CpG*: Coly	Very poor.	Very poor.	Poor	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Hobbs	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
CuE2*: Coly	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Uly	Poor	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
DuB, DuC: Dunday	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Eb: Els	Poor	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair.
EfB*: Els	Poor	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
Ipage	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Em: Elsmere	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
EnB*: Elsmere	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
Ipage	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Ep*: Elsmere	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ep*:												
Loup	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Eu*:												
Elsmere	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
Selia	Poor	Poor	Poor	Poor	Poor	Poor	Fair	Fair	Poor	Poor	Fair	Poor.
Fu. Fluvaquents												
GfB Gates	Good	Good	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
GfC, GfD Gates	Fair	Good	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Gk Gibbon	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Good	Fair	Good.
HaB Hall	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
HeB Hersh	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
Hk Hobbs	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
HtB Hord	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
IfB, IgB Ipage	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
LfB Libory	Fair	Fair	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Good.
Ln Loretto	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Lo, Lr Loup	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Ma Marlake	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
Nb Nimbro	Good	Good	Fair	Good	Very poor.	Good	Very poor.	Very poor.	Good	Very poor.	Very poor.	Fair.
Or Ord	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good.
Tn, Tp Tryon	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Ts*:												
Tryon	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ts*:												
Inavale	Very poor.	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
UbC, UbD2 Uly	Fair	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
VaB, VaD, VaE Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VaF*:												
Valentine, rolling	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Valentine, hilly	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
VeB Valentine	Fair	Good	Fair	Poor	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VfD*:												
Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Dunday	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
VmD*:												
Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Els	Poor	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
An: Anselmo	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
AnC: Anselmo	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Bg*: Blownout land.						
Valentine	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
BsB: Boelus	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
BsC: Boelus	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
CoD2: Coly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
CoF: Coly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
CpG*: Coly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hobbs	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
CuE2*: Coly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Uly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
DuB: Dunday	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
DuC: Dunday	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Eb: Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
EfB*:						
Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Ipage	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Severe: droughty.
Em Elsmere	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
EnB*:						
Elsmere	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Ipage	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Severe: droughty.
Ep*:						
Elsmere	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Loup	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
Eu*:						
Elsmere	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Selia	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Severe: excess sodium.
Fu. Fluvaquents						
GfB Gates	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
GfC Gates	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
GfD Gates	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Gk Gibbon	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.	Moderate: wetness, flooding.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
HaB------------- Hall	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
HeB------------- Hersh	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
Hk-------------- Hobbs	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
HtB------------- Hord	Slight---------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
IfB, IgB--------- Ipage	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Moderate: frost action.	Severe: droughty.
LfB------------- Libory	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Ln-------------- Loretto	Slight---------	Slight---------	Slight---------	Slight---------	Severe: low strength.	Slight.
Lo-------------- Loup	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
Lr-------------- Loup	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.
Ma-------------- Marlake	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Nb-------------- Nimbro	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Or-------------- Ord	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: frost action.	Moderate: wetness.
Tn-------------- Tryon	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
Tp-------------- Tryon	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.
Ts*:						
Tryon-----------	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.
Inavale----------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
UbC------------- Uly	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength.	Slight.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
UbD2: Uly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
VaB: Valentine	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
VaD: Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VaE: Valentine	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
VaF*:						
Valentine, rolling	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Valentine, hilly	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VeB: Valentine	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
VfD*:						
Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Dunday	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VmD*:						
Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
An, AnC: Anselmo	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Bg*: Blownout land.					
Valentine	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
BsB: Boelus	Slight	Moderate: seepage.	Slight	Slight	Good.
BsC: Boelus	Slight	Moderate: slope.	Slight	Slight	Good.
CoD2: Coly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
CoF: Coly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
CpG*: Coly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Hobbs	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
CuE2*: Coly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Uly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
DuB, DuC: Dunday	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Eb: Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
EfB*: Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
EfB*:					
Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Em Elsmere	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
EnB*:					
Elsmere	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Ep*:					
Elsmere	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Loup	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Eu*:					
Elsmere	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Selia	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, excess sodium.
Fu. Fluvaquents					
GfB, GfC Gates	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
GfD Gates	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
Gk Gibbon	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
HaB Hall	Slight	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HeB: Hersh	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Hk: Hobbs	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
HtB: Hord	Moderate: flooding.	Moderate: seepage, slope.	Moderate: flooding.	Moderate: flooding.	Good.
IfB, IgB: Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
LfB: Libory	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage.	Fair: too clayey, wetness.
Ln: Loretto	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too clayey.
Lo: Loup	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Lr: Loup	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Ma: Marlake	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Nb: Nimbro	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Or: Ord	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Tn: Tryon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Tp: Tryon	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Ts*:					
Tryon	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ts*:					
Inavale	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
UbC Uly	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
UbD2 Uly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
VaB, VaD Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VaE Valentine	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VaF*:					
Valentine, rolling	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Valentine, hilly	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
VeB Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VfD*:					
Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Dunday	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VmD*:					
Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
An, AnC: Anselmo	Good	Probable	Improbable: too sandy.	Fair: thin layer.
Bg*: Blowout land.				
Valentine	Good	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy.
BsB, BsC: Boelus	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
CoD2: Coly	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
CoF: Coly	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
CpG*: Coly	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Hobbs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
CuE2*: Coly	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
DuB, DuC: Dunday	Good	Probable	Improbable: too sandy.	Poor: thin layer.
Eb: Els	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
EfB*: Els	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Ipage	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Em: Elsmere	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.
EnB*: Elsmere	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
EnB*:				
Ipage	Good	Probable	Improbable: too sandy.	Fair: too sandy.
Ep*:				
Elsmere	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.
Loup	Poor: wetness.	Probable	Improbable: too sandy.	Poor: thin layer, wetness.
Eu*:				
Elsmere	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.
Selia	Fair: wetness.	Probable	Improbable: too sandy.	Poor: excess sodium, area reclaim.
Fu. Fluvaquents				
GfB, GfC Gates	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
GfD Gates	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Gk Gibbon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
HaB Hall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
HeB Hersh	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Hk Hobbs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
HtB Hord	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
IfB Ipage	Good	Probable	Improbable: too sandy.	Poor: too sandy.
IgB Ipage	Good	Probable	Improbable: too sandy.	Fair: too sandy.
LfB Libory	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Ln Loretto	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lo Loup	Poor: wetness.	Probable	Improbable: too sandy.	Poor: thin layer, wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Lr------ Loup	Poor: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: thin layer, wetness.
Ma------ Marlake	Poor: wetness.	Probable------	Improbable: too sandy.	Poor: thin layer, wetness.
Nb------ Nimbro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Or------ Ord	Fair: wetness.	Probable------	Improbable: too sandy.	Fair: thin layer.
Tn------ Tryon	Poor: wetness.	Probable------	Improbable: too sandy.	Poor: wetness.
Tp------ Tryon	Poor: wetness.	Probable------	Improbable: too sandy.	Poor: small stones, wetness.
Ts*:				
Tryon------	Poor: wetness.	Probable------	Improbable: too sandy.	Poor: wetness.
Inavale------	Good------	Probable------	Improbable: too sandy.	Poor: too sandy.
UbC------ Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
UbD2------ Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
VaB, VaD, VaE------ Valentine	Good------	Probable------	Improbable: too sandy.	Poor: area reclaim, too sandy.
VaF*:				
Valentine, rolling---	Good------	Probable------	Improbable: too sandy.	Poor: area reclaim, too sandy.
Valentine, hilly-----	Poor: slope.	Probable------	Improbable: too sandy.	Poor: area reclaim, too sandy, slope.
VeB------ Valentine	Good------	Probable------	Improbable: too sandy.	Poor: area reclaim.
VfD*:				
Valentine------	Good------	Probable------	Improbable: too sandy.	Poor: area reclaim.
Dunday------	Good------	Probable------	Improbable: too sandy.	Poor: thin layer.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
VmD*:				
Valentine	Good	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy.
Els	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "moderate" and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
An: Anselmo	Severe: seepage.	Severe: seepage, piping.	Deep to water	Favorable	Too sandy, soil blowing.	Favorable.
AnC: Anselmo	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope	Too sandy, soil blowing.	Favorable.
Bg*: Blownout land.						
Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
BsB: Boelus	Moderate: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Erodes easily, soil blowing.	Erodes easily.
BsC: Boelus	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, fast intake, soil blowing.	Erodes easily, soil blowing.	Erodes easily.
CoD2, CoF: Coly	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
CpG*: Coly	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Hobbs	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, flooding.	Favorable	Favorable.
CuE2*: Coly	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Uly	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
DuB, DuC: Dunday	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Eb: Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
EfB*: Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
EfB*:						
Ipage	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Em Elsmere	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
EnB*:						
Elsmere	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
Ipage	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Ep*:						
Elsmere	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
Loup	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
Eu*:						
Elsmere	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
Selia	Severe: seepage.	Severe: seepage, piping, wetness.	Percs slowly, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Excess sodium, droughty, percs slowly.
Fu. Fluvaquents						
GfB Gates	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, erodes easily.	Erodes easily, soil blowing.	Erodes easily.
GfC Gates	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope, erodes easily.	Erodes easily, soil blowing.	Erodes easily.
GfD Gates	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope, erodes easily.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
Gk Gibbon	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Favorable.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
HaB: Hall	Moderate: seepage.	Moderate: thin layer.	Deep to water	Favorable	Erodes easily	Erodes easily.
HeB: Hersh	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Soil blowing	Favorable.
Hk: Hobbs	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
HtB: Hord	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
IfB, IgB: Ipage	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
LfB: Libory	Severe: seepage.	Severe: piping.	Favorable	Wetness, droughty, fast intake.	Erodes easily, wetness, soil blowing.	Erodes easily, droughty.
Ln: Loretto	Severe: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Lo: Loup	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
Lr: Loup	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty.	Ponding, too sandy.	Wetness, droughty.
Ma: Marlake	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty.
Nb: Nimbro	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Or: Ord	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Rooting depth.
Tn: Tryon	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy.	Wetness, droughty.
Tp: Tryon	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy.	Wetness, droughty.
Ts*: Tryon	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy.	Wetness, droughty.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ts*:						
Inavale----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
UbC--------------- Uly	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
UbD2-------------- Uly	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
VaB, VaD---------- Valentine	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
VaE--------------- Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
VaF*:						
Valentine, rolling---------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Valentine, hilly-	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
VeB--------------- Valentine	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
VfD*:						
Valentine--------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Dunday-----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
VmD*:						
Valentine--------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Els--------------	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
An, AnC---------- Anselmo	0-16	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	100	100	60-100	30-65	<25	NP-7
	16-28	Fine sandy loam, loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	100	90-100	35-65	<25	NP-7
	28-60	Fine sandy loam, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-4, A-2	0	100	100	65-100	12-45	<25	NP-7
Bg*: Blowout land.											
Valentine-------	0-4	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
	4-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
BsB, BsC--------- Boelus	0-14	Loamy sand, loamy fine sand.	SM, SP-SM	A-2	0	100	100	50-100	10-35	<20	NP-5
	14-22	Loamy fine sand, loamy sand, fine sand.	SM, SP-SM	A-2	0	100	100	50-100	10-35	<20	NP
	22-34	Silt loam, loam, sandy clay loam.	CL	A-4, A-6	0	100	100	90-100	70-100	30-40	8-15
	34-60	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	100	90-100	80-100	30-40	8-18
CoD2, CoF-------- Coly	0-4	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	85-100	20-40	2-15
	4-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4	0	100	100	85-100	85-100	20-35	2-10
CpG*: Coly------------	0-4	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	85-100	20-40	2-15
	4-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4	0	100	100	85-100	85-100	20-35	2-10
Hobbs-----------	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	6-60	Silt loam, silty clay loam, very fine sandy loam.	CL, CL-ML, MH	A-4, A-6, A-7	0	100	100	95-100	80-100	25-55	5-25
CuE2*: Coly------------	0-5	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	85-100	20-40	2-15
	5-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4	0	100	100	85-100	85-100	20-35	2-10
Uly-------------	0-6	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	6-16	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	16-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
DuB, DuC--------- Dunday	0-14	Loamy fine sand	SM, SM-SC	A-2	0	100	100	90-100	13-35	<25	NP-4
	14-60	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	50-100	5-35	<25	NP-4
Eb--------------- Els	0-7	Loamy sand-------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	7-60	Fine sand, loamy sand, sand.	SP-SM, SM, SP	A-2, A-3	0	90-100	90-100	70-100	4-30	---	NP
EfB*:											
Els--------------	0-6	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	6-60	Fine sand, loamy sand, sand.	SP-SM, SM, SP	A-2, A-3	0	90-100	90-100	70-100	4-30	---	NP
Ipage------------	0-5	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	100	50-70	5-30	---	NP
	5-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-95	2-30	---	NP
Em--------------- Elsmere	0-16	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	16-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	100	60-100	5-30	---	NP
EnB*:											
Elsmere----------	0-12	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	12-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	100	60-100	5-30	---	NP
Ipage------------	0-6	Loamy fine sand	SM, SP-SM	A-2	0	100	100	50-90	10-35	---	NP
	6-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-95	2-30	---	NP
Ep*:											
Elsmere----------	0-18	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	18-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	100	60-100	5-30	---	NP
Loup-------------	0-16	Fine sandy loam, sandy loam.	SM, SM-SC	A-2	0	100	100	70-95	20-35	<20	NP-6
	16-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	65-100	5-20	---	NP
Eu*:											
Elsmere----------	0-14	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	14-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	100	60-100	5-30	---	NP
Selia------------	0-5	Loamy fine sand	SM	A-2, A-4	0	100	100	50-85	15-40	---	NP
	5-28	Loamy fine sand, loamy sand.	SM	A-2, A-4	0	100	100	50-85	15-40	---	NP
	28-60	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2	0	100	100	50-85	10-35	---	NP
Fu. Fluvaquents											

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
GfB, GfC, GfD---- Gates	0-5	Very fine sandy loam.	ML	A-4	0	100	100	95-100	65-100	20-40	NP-10
	5-18	Very fine sandy loam.	ML	A-4	0	100	100	95-100	65-100	20-40	NP-10
	18-60	Very fine sandy loam, silt loam, loamy very fine sand.	ML, SM	A-4	0	100	100	95-100	35-100	20-40	NP-10
Gk--------------- Gibbon	0-20	Loam-------------	ML, CL, CL-ML	A-4	0	100	100	85-100	70-90	20-30	2-10
	20-26	Silt loam, clay loam, loam.	CL	A-6	0	100	100	90-100	55-90	25-38	12-20
	26-60	Stratified fine sandy loam to silt loam.	SM, SC, CL, ML	A-4	0	100	100	70-95	35-90	<25	NP-8
HaB-------------- Hall	0-6	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	95-100	25-40	3-18
	6-24	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	15-30
	24-38	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-20
	38-60	Stratified fine sandy loam to silt loam.	CL-ML, ML, CL	A-4	0	100	100	85-100	75-100	<20	2-8
HeB-------------- Hersh	0-6	Fine sandy loam	SM, SC, SM-SC, ML	A-4	0	100	100	85-100	40-75	<25	NP-10
	6-14	Fine sandy loam, loamy very fine sand.	SM, SM-SC, ML, CL-ML	A-4	0	100	100	80-100	40-65	<20	NP-5
	14-60	Fine sandy loam, fine sand, very fine sandy loam.	SM, SM-SC	A-4, A-2	0	100	100	80-100	25-50	<20	NP-5
Hk--------------- Hobbs	0-7	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	7-60	Silt loam, silty clay loam, very fine sandy loam.	CL, CL-ML, MH	A-4, A-6, A-7	0	100	100	95-100	80-100	25-55	5-25
HtB-------------- Hord	0-22	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	3-18
	22-48	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	98-100	85-100	25-40	8-23
	48-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	100	85-100	25-40	6-21
IfB-------------- Ipage	0-7	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	100	50-70	5-30	---	NP
	7-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-95	2-30	---	NP
IgB-------------- Ipage	0-4	Loamy sand-------	SM, SP-SM	A-2	0	100	100	50-90	10-35	---	NP
	4-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-95	2-30	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
LfB Libory	0-13	Loamy fine sand	SM	A-2, A-4	0	100	100	65-85	15-45	---	NP
	13-25	Loamy fine sand, loamy sand, fine sand.	SM, SP-SM	A-2	0	100	100	55-80	12-35	---	NP
	25-60	Silty clay loam, silt loam, very fine sandy loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-95	20-40	4-24
Ln Loretto	0-13	Loam	CL, CL-ML	A-6, A-4	0	100	100	85-100	60-90	25-40	5-15
	13-26	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	85-100	80-100	30-45	11-25
	26-60	Loam, silt loam, silty clay loam.	CL	A-6, A-7, A-4	0	100	100	80-100	80-100	30-47	8-25
Lo Loup	0-16	Fine sandy loam	SM, SM-SC	A-2	0	100	100	70-95	20-35	<20	NP-6
	16-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	65-100	5-20	---	NP
Lr Loup	0-14	Fine sandy loam, loam.	SM, SM-SC	A-2	0	100	100	70-95	20-35	<20	NP-6
	14-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	65-100	5-20	---	NP
Ma Marlake	0-7	Loamy fine sand	SM	A-2, A-4	0	100	100	50-85	15-50	---	NP
	7-22	Fine sand, loamy sand, loamy fine sand.	SP-SM, SM	A-2, A-4, A-3	0	100	100	50-85	5-50	---	NP
	22-60	Sand, fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	100	50-80	5-35	---	NP
Nb Nimbro	0-20	Silt loam	ML, CL	A-4, A-6, A-7	0	95-100	95-100	80-100	65-95	25-45	8-18
	20-60	Stratified loam to silty clay loam.	CL	A-6, A-7	0	90-100	90-100	80-100	70-95	30-45	11-20
Or Ord	0-14	Loam	ML	A-4	0	100	100	95-100	95-100	25-35	2-8
	14-26	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-2, A-4	0	95-100	95-100	70-100	30-85	20-35	NP-10
	26-60	Stratified sand to loamy fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	95-100	95-100	50-100	5-30	<20	NP-5
Tn Tryon	0-7	Loamy fine sand	SM, SP-SM	A-2	0	100	100	85-100	10-30	---	NP
	7-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-30	---	NP
Tp Tryon	0-5	Loamy fine sand	SM, SP-SM	A-2	0	100	100	85-100	10-30	---	NP
	5-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	50-90	50-90	5-30	---	NP
Ts*:											
Tryon	0-5	Loamy fine sand	SM, SP-SM	A-2	0	100	100	85-100	10-30	---	NP
	5-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-30	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ts*:											
Inavale---------	0-6	Loamy sand-------	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	85-95	5-35	<25	NP-5
	6-14	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	14-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
UbC-------------	0-11	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
Uly	11-32	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	32-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
UbD2------------	0-7	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
Uly	7-27	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	27-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
VaB, VaD, VaE---- Valentine	0-5	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
	5-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
VaF*------------	0-3	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
Valentine	3-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
VeB------------- Valentine	0-9	Loamy fine sand	SM, SP-SM, SP	A-2, A-3	0	100	100	95-100	2-35	---	NP
	9-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
VfD*:											
Valentine-------	0-7	Loamy fine sand	SM, SP-SM, SP	A-2, A-3	0	100	100	95-100	2-35	---	NP
	7-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
Dunday----------	0-13	Loamy fine sand	SM, SM-SC	A-2	0	100	100	90-100	13-35	<25	NP-4
	13-60	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	50-95	5-35	<25	NP-4
VmD*:											
Valentine-------	0-5	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
	5-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
Els-------------	0-6	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	6-60	Fine sand, loamy sand, sand.	SP-SM, SM, SP	A-2, A-3	0	90-100	90-100	70-100	4-30	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
An, AnC---------- Anselmo	0-16	10-18	1.30-1.60	0.6-6.0	0.13-0.18	5.6-7.8	<2	Low--------	0.20	5	3	1-2
	16-28	10-18	1.40-1.60	2.0-6.0	0.15-0.19	5.6-7.8	<2	Low--------	0.20			
	28-60	5-18	1.50-1.70	2.0-6.0	0.08-0.16	5.6-7.8	<2	Low--------	0.20			
Bg*:												
Blownout land.												
Valentine--------	0-4	0-6	1.70-1.90	6.0-20	0.07-0.09	5.6-7.3	<2	Low--------	0.15	5	1	.5-1
	4-60	0-8	1.70-1.90	6.0-20	0.05-0.11	5.6-7.3	<2	Low--------	0.15			
BsB, BsC--------- Boelus	0-14	2-12	1.70-1.90	6.0-20	0.10-0.12	5.6-7.3	<2	Low--------	0.17	5	2	1-2
	14-22	2-12	1.70-1.90	6.0-20	0.09-0.11	6.1-7.8	<2	Low--------	0.17			
	22-34	15-35	1.40-1.60	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.43			
	34-60	15-35	1.30-1.50	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.43			
CoD2, CoF-------- Coly	0-4	18-24	1.30-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	1-2
	4-60	18-24	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
CpG*:												
Coly-------------	0-4	18-24	1.30-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	1-2
	4-60	18-24	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
Hobbs------------	0-6	15-30	1.20-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low--------	0.32	5	6	2-4
	6-60	15-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.32			
CuE2*:												
Coly-------------	0-5	18-24	1.30-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	1-2
	5-60	18-24	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
Uly--------------	0-6	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.32	5	6	1-2
	6-16	20-30	1.20-1.30	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
	16-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
DuB, DuC--------- Dunday	0-14	3-10	1.40-1.60	6.0-20	0.10-0.12	6.1-7.3	<2	Low--------	0.17	5	2	1-2
	14-60	2-7	1.50-1.70	6.0-20	0.09-0.11	6.1-7.8	<2	Low--------	0.17			
Eb--------------- Els	0-7	2-8	1.60-1.80	6.0-20	0.07-0.12	6.1-8.4	<2	Low--------	0.17	5	1	1-2
	7-60	0-8	1.50-1.60	6.0-20	0.05-0.08	6.1-8.4	<2	Low--------	0.15			
EfB*:												
Els--------------	0-6	2-8	1.60-1.80	6.0-20	0.07-0.12	6.1-8.4	<2	Low--------	0.15	5	1	1-2
	6-60	0-8	1.50-1.60	6.0-20	0.05-0.08	6.1-8.4	<2	Low--------	0.15			
Ipage------------	0-5	1-5	1.40-1.50	6.0-20	0.07-0.09	5.6-7.3	<2	Low--------	0.15	5	1	.5-1
	5-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.6-7.3	<2	Low--------	0.15			
Em--------------- Elsmere	0-16	3-10	1.90-2.10	6.0-20	0.10-0.12	5.6-8.4	<2	Low--------	0.17	5	2	2-3
	16-60	0-8	1.90-2.10	6.0-20	0.06-0.11	5.6-8.4	<2	Low--------	0.17			
EnB*:												
Elsmere----------	0-12	3-10	1.90-2.10	6.0-20	0.10-0.12	5.6-8.4	<2	Low--------	0.17	5	2	2-3
	12-60	0-8	1.90-2.10	6.0-20	0.06-0.11	5.6-8.4	<2	Low--------	0.17			
Ipage------------	0-6	3-10	1.40-1.50	6.0-20	0.10-0.12	5.6-7.3	<2	Low--------	0.17	5	2	.5-1
	6-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.6-7.3	<2	Low--------	0.15			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ep*:												
Elsmere---------	0-18	3-10	1.90-2.10	6.0-20	0.10-0.12	5.6-8.4	<2	Low-------	0.17	5	2	2-3
	18-60	0-8	1.90-2.10	6.0-20	0.06-0.11	5.6-8.4	<2	Low-------	0.17			
Loup-----------	0-16	5-15	1.30-1.50	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low-------	0.20	5	8	4-8
	16-60	2-7	1.50-1.70	6.0-20	0.06-0.08	6.6-8.4	<2	Low-------	0.17			
Eu*:												
Elsmere---------	0-14	3-10	1.90-2.10	6.0-20	0.10-0.12	5.6-8.4	<2	Low-------	0.17	5	2	2-3
	14-60	0-8	1.90-2.10	6.0-20	0.06-0.11	5.6-8.4	<2	Low-------	0.17			
Selia-----------	0-5	3-12	1.80-1.90	6.0-20	0.10-0.12	6.6-9.0	<4	Low-------	0.17	3	2	2-4
	5-28	6-15	1.70-2.00	0.06-0.2	0.09-0.12	>8.4	<8	Low-------	0.17			
	28-60	1-8	1.80-2.10	2.0-6.0	0.06-0.10	>8.4	<8	Low-------	0.17			
Fu. Fluvaquents												
GfB, GfC, GfD---- Gates	0-5	14-17	1.20-1.40	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low-------	0.37	5	3	<1
	5-18	13-15	1.20-1.40	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low-------	0.37			
	18-60	14-17	1.20-1.40	0.6-6.0	0.17-0.19	7.4-8.4	<2	Low-------	0.37			
Gk-------------- Gibbon	0-20	20-25	1.40-1.60	0.6-2.0	0.21-0.23	7.4-8.4	<2	Low-------	0.32	5	4L	2-4
	20-26	20-27	1.30-1.50	0.6-2.0	0.18-0.22	7.9-8.4	<2	Moderate	0.32			
	26-60	15-25	1.50-1.70	0.6-6.0	0.16-0.20	7.9-9.0	<2	Low-------	0.32			
HaB------------- Hall	0-6	20-27	1.30-1.40	0.6-2.0	0.20-0.24	6.1-7.3	<2	Moderate	0.32	5	6	2-4
	6-24	28-35	1.30-1.50	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.43			
	24-38	15-30	1.30-1.40	0.6-2.0	0.18-0.22	6.6-7.8	<2	Moderate	0.43			
	38-60	12-30	1.40-1.60	0.6-6.0	0.14-0.20	6.6-8.4	<2	Low-------	0.43			
HeB------------- Hersh	0-6	10-18	1.30-1.50	2.0-6.0	0.16-0.18	6.1-7.3	<2	Low-------	0.24	5	3	.5-1
	6-14	8-18	1.30-1.50	2.0-6.0	0.15-0.18	6.1-7.3	<2	Low-------	0.24			
	14-60	10-18	1.20-1.50	2.0-6.0	0.14-0.16	6.6-7.8	<2	Low-------	0.24			
Hk-------------- Hobbs	0-7	15-30	1.20-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low-------	0.32	5	6	2-4
	7-60	15-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low-------	0.32			
HtB------------- Hord	0-22	17-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low-------	0.32	5	6	2-4
	22-48	20-35	1.35-1.45	0.6-2.0	0.17-0.22	6.1-8.4	<2	Low-------	0.32			
	48-60	18-30	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-------	0.43			
IfB------------- Ipage	0-7	1-5	1.40-1.50	6.0-20	0.07-0.09	5.6-7.3	<2	Low-------	0.15	5	1	.5-1
	7-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.6-7.3	<2	Low-------	0.15			
IgB------------- Ipage	0-4	3-10	1.40-1.50	6.0-20	0.10-0.12	5.6-7.3	<2	Low-------	0.17	5	2	.5-2
	4-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.6-7.3	<2	Low-------	0.15			
LfB------------- Libory	0-13	2-12	1.60-1.80	6.0-20	0.07-0.12	5.6-7.3	<2	Low-------	0.17	5	2	1-2
	13-25	2-12	1.60-1.80	6.0-20	0.06-0.11	5.6-7.3	<2	Low-------	0.17			
	25-60	15-32	1.20-1.40	0.2-2.0	0.17-0.22	5.6-7.8	<2	Low-------	0.43			
Ln-------------- Loretto	0-13	10-20	1.30-1.50	0.6-2.0	0.20-0.22	5.1-6.5	<2	Low-------	0.28	5	6	2-3
	13-26	20-35	1.30-1.40	0.6-6.0	0.17-0.20	5.6-7.3	<2	Low-------	0.28			
	26-60	18-30	1.40-1.50	0.6-6.0	0.17-0.20	6.1-8.4	<2	Low-------	0.28			
Lo-------------- Loup	0-16	5-15	1.30-1.50	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low-------	0.20	5	8	4-8
	16-60	2-7	1.50-1.70	6.0-20	0.06-0.08	6.6-8.4	<2	Low-------	0.17			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Lr--------------- Loup	0-14 14-60	5-15 2-7	1.30-1.50 1.50-1.70	2.0-6.0 6.0-20	0.16-0.18 0.06-0.08	6.6-8.4 6.6-8.4	<2 <2	Low-------- Low--------	0.20 0.17	5	8	4-8
Ma--------------- Marlake	0-7 7-22 22-60	3-10 3-8 0-5	1.50-1.60 1.50-1.60 1.50-1.60	6.0-20 6.0-20 6.0-20	0.10-0.14 0.06-0.11 0.05-0.07	6.6-8.4 6.6-8.4 6.6-8.4	<2 <2 <2	Low-------- Low-------- Low--------	0.17 0.17 0.17	2	8	4-8
Nb--------------- Nimbro	0-20 20-60	20-26 20-35	1.15-1.30 1.20-1.40	0.6-2.0 0.6-2.0	0.18-0.22 0.16-0.20	7.4-8.4 7.4-8.4	<2 <2	Moderate Moderate	0.28 0.28	5	6	2-4
Or--------------- Ord	0-14 14-26 26-60	8-15 8-15 3-12	1.40-1.60 1.50-1.70 1.60-1.80	0.6-2.0 2.0-6.0 2.0-20	0.20-0.22 0.15-0.17 0.02-0.04	7.4-8.4 6.6-8.4 6.6-8.4	<2 <2 <2	Low-------- Low-------- Low--------	0.28 0.20 0.20	5	4L	2-4
Tn--------------- Tryon	0-7 7-60	3-10 1-7	1.40-1.60 1.50-1.70	6.0-20 6.0-20	0.10-0.12 0.06-0.08	5.6-8.4 5.6-7.8	<2 <2	Low-------- Low--------	0.17 0.17	5	8	4-8
Tp--------------- Tryon	0-5 5-60	3-10 1-7	1.40-1.60 1.50-1.70	6.0-20 6.0-20	0.10-0.12 0.06-0.08	5.6-8.4 5.6-7.8	<2 <2	Low-------- Low--------	0.17 0.17	5	8	4-8
Ts*:												
Tryon----------- 	0-5 5-60	3-10 1-7	1.40-1.60 1.50-1.70	6.0-20 6.0-20	0.10-0.12 0.06-0.08	5.6-8.4 5.6-7.8	<2 <2	Low-------- Low--------	0.17 0.17	5	8	4-8
Inavale----------	0-6 6-14 14-60	7-18 3-10 3-10	1.50-1.60 1.50-1.60 1.50-1.60	6.0-20 6.0-20 6.0-20	0.10-0.12 0.06-0.11 0.05-0.10	6.1-7.8 6.6-8.4 6.6-8.4	<2 <2 <2	Low-------- Low-------- Low--------	0.17 0.17 0.17	5	2	.5-1
UbC-------------- Uly	0-11 11-32 32-60	17-27 20-30 18-27	1.20-1.30 1.20-1.30 1.10-1.20	0.6-2.0 0.6-2.0 0.6-2.0	0.20-0.24 0.18-0.22 0.18-0.22	6.1-7.8 6.1-8.4 7.4-8.4	<2 <2 <2	Low-------- Low-------- Low--------	0.32 0.43 0.43	5	6	1-2
UbD2------------- Uly	0-7 7-27 27-60	17-27 20-30 18-27	1.20-1.30 1.20-1.30 1.10-1.20	0.6-2.0 0.6-2.0 0.6-2.0	0.20-0.24 0.18-0.22 0.18-0.22	6.1-7.8 6.6-8.4 7.4-8.4	<2 <2 <2	Low-------- Low-------- Low--------	0.32 0.43 0.43	5	6	1-2
VaB, VaD, VaE---- Valentine	0-5 5-60	0-6 0-8	1.70-1.90 1.70-1.90	6.0-20 6.0-20	0.07-0.09 0.05-0.11	5.6-7.3 5.6-7.3	<2 <2	Low-------- Low--------	0.15 0.15	5	1	.5-1
VaF*------------- Valentine	0-3 3-60	0-6 0-8	1.70-1.90 1.70-1.90	6.0-20 6.0-20	0.07-0.09 0.05-0.11	5.6-7.3 5.6-7.3	<2 <2	Low-------- Low--------	0.15 0.15	5	1	.5-1
VeB-------------- Valentine	0-9 9-60	2-10 0-8	1.70-1.90 1.70-1.90	6.0-20 6.0-20	0.10-0.12 0.05-0.11	5.6-7.3 5.6-7.3	<2 <2	Low-------- Low--------	0.17 0.15	5	2	.5-1
VfD*:												
Valentine-------	0-7 7-60	2-10 0-8	1.70-1.90 1.70-1.90	6.0-20 6.0-20	0.10-0.12 0.05-0.11	5.6-7.3 5.6-7.3	<2 <2	Low-------- Low--------	0.17 0.15	5	2	.5-1
Dunday-----------	0-13 13-60	3-10 2-7	1.40-1.60 1.50-1.70	6.0-20 6.0-20	0.10-0.12 0.09-0.11	6.1-7.3 6.1-7.8	<2 <2	Low-------- Low--------	0.17 0.17	5	2	1-2
VmD*:												
Valentine-------	0-5 5-60	0-6 0-8	1.70-1.90 1.70-1.90	6.0-20 6.0-20	0.07-0.09 0.05-0.11	5.6-7.3 5.6-7.3	<2 <2	Low-------- Low--------	0.15 0.15	5	1	.5-1
Els--------------	0-6 6-60	2-8 0-8	1.60-1.80 1.50-1.60	6.0-20 6.0-20	0.07-0.12 0.05-0.08	6.1-8.4 6.1-8.4	<2 <2	Low-------- Low--------	0.15 0.15	5	1	1-2

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft					
An, AnC----------- Anselmo	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
Bg*: Blownout land.										
Valentine--------	A	None--------	---	---	>6.0	---	---	Low------	Low------	Low.
BsB, BsC---------- Boelus	A	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
CoD2, CoF--------- Coly	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
CpG*: Coly-------------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
Hobbs------------	B	Occasional	Brief-----	Apr-Sep	>6.0	---	---	Moderate	Low------	Low.
CuE2*: Coly-------------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
Uly--------------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Low.
DuB, DuC---------- Dunday	A	None--------	---	---	>6.0	---	---	Low------	Low------	Low.
Eb---------------- Els	A	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	Moderate	Moderate	Low.
EfB*: Els--------------	A	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	Moderate	Moderate	Low.
Ipage------------	A	None--------	---	---	3.0-6.0	Apparent	Dec-Jun	Moderate	Low------	Moderate.
Em---------------- Elsmere	A	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	Moderate	Moderate	Low.
EnB*: Elsmere----------	A	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	Moderate	Moderate	Low.
Ipage------------	A	None--------	---	---	3.0-6.0	Apparent	Dec-Jun	Moderate	Low------	Moderate.
Ep*: Elsmere----------	A	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	Moderate	Moderate	Low.
Loup-------------	D	Rare--------	---	---	0-1.5	Apparent	Nov-May	Moderate	High-----	Low.
Eu*: Elsmere----------	A	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	Moderate	Moderate	Low.
Selia------------	C	Rare--------	---	---	1.5-2.5	Apparent	Nov-Jun	Moderate	High-----	Moderate.
Fu. Fluvaquents										

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
GfB, GfC, GfD: Gates	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Gk: Gibbon	B	Occasional	Very brief	Mar-Jul	1.5-3.0	Apparent	Nov-Jun	High	High	Low.
HaB: Hall	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
HeB: Hersh	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Hk: Hobbs	B	Occasional	Brief	Apr-Sep	>6.0	---	---	Moderate	Low	Low.
HtB: Hord	B	Rare	---	---	>6.0	---	---	Moderate	High	Low.
IfB, IgB: Ipage	A	None	---	---	3.0-6.0	Apparent	Dec-Jun	Moderate	Low	Moderate.
LfB: Libory	A	None	---	---	1.5-3.0	Perched	Mar-Jun	Low	Moderate	Low.
Ln: Loretto	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
Lo: Loup	D	Rare	---	---	0-1.5	Apparent	Nov-May	Moderate	High	Low.
Lr: Loup	D	Rare	---	---	+.5-1.0	Apparent	Nov-May	Moderate	High	Low.
Ma: Marlake	D	None	---	---	+2-1.0	Apparent	Oct-Jun	Moderate	High	Low.
Nb: Nimbro	B	None	---	---	>6.0	---	---	Moderate	High	Low.
Or: Ord	B	Rare	---	---	1.5-3.5	Apparent	Nov-May	High	High	Low.
Tn: Tryon	D	Rare	---	---	0-1.5	Apparent	Nov-May	Moderate	High	Low.
Tp: Tryon	D	Rare	---	---	+.5-1.0	Apparent	Nov-May	Moderate	High	Low.
Ts*:										
Tryon	D	Frequent	Brief	Jan-Jul	0-1.5	Apparent	Nov-May	Moderate	High	Low.
Inavale	A	Rare	---	---	>6.0	---	---	Low	Moderate	Low.
UbC, UbD2: Uly	B	None	---	---	>6.0	---	---	Moderate	High	Low.
VaB, VaD, VaE: Valentine	A	None	---	---	>6.0	---	---	Low	Low	Low.
VaF*: Valentine	A	None	---	---	>6.0	---	---	Low	Low	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
VeB----------------- Valentine	A	None---------	---	---	>6.0	---	---	Low-------	Low-------	Low.
VfD*:										
Valentine---------	A	None---------	---	---	>6.0	---	---	Low-------	Low-------	Low.
Dunday------------	A	None---------	---	---	>6.0	---	---	Low-------	Low-------	Low.
VmD*:										
Valentine---------	A	None---------	---	---	>6.0	---	---	Low-------	Low-------	Low.
Els---------------	A	Rare---------	---	---	1.5-3.0	Apparent	Nov-May	Moderate	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--ENGINEERING INDEX TEST DATA

[Dashes indicate that data were not available. LL means liquid limit; PI, plasticity index; and NP, nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									LL	PI	Specific gravity
			Percentage passing sieve--						Percentage smaller than--					
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm			
												Pct		g/cc
Boelus loamy sand: (S81NE-183-1)														
A------ 6 to 14	A-2-4 (0)	SM	---	---	---	100	97	27	18	7	5	18	1	2.60
2Bw---- 22 to 34	A-6(10)	CL	---	---	---	100	99	73	44	26	24	33	15	2.63
2C----- 34 to 60	A-6(9)	CL	---	---	---	---	100	93	83	26	21	34	13	2.65
Dunday loamy fine sand: (S82NE-183-1)														
C2----- 38 to 60	A-2-4 (0)	SM	---	---	---	100	97	16	9	4	3	NP	NP	2.65

* Locations of the sampled pedons are as follows:

Boelus loamy sand: 2,500 feet south and 50 feet east of the northwest corner of sec. 11, T. 24 N., R. 9 W.

Dunday loamy fine sand: 200 feet south and 2,400 feet west of the northeast corner of sec. 11, T. 23 N., R. 9 W.

TABLE 20.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Anselmo	Coarse-loamy, mixed, mesic Typic Haplustolls
Boelus	Sandy over loamy, mixed, mesic Udic Haplustolls
Coly	Fine-silty, mixed (calcareous), mesic Typic Ustorthents
Dunday	Sandy, mixed, mesic Entic Haplustolls
Els	Mixed, mesic Aquic Ustipsamments
Elsmere	Sandy, mixed, mesic Aquic Haplustolls
Gates	Coarse-silty, mixed, nonacid, mesic Typic Ustorthents
*Gibbon	Fine-silty, mixed (calcareous), mesic Fluvaquentic Haplaquolls
Hall	Fine-silty, mixed, mesic Pachic Argiustolls
Hersh	Coarse-loamy, mixed, nonacid, mesic Typic Ustorthents
Hobbs	Fine-silty, mixed, nonacid, mesic Mollic Ustifluvents
Hord	Fine-silty, mixed, mesic Cumulic Haplustolls
Inavale	Sandy, mixed, mesic Typic Ustifluvents
Ipage	Mixed, mesic Aquic Ustipsamments
Libory	Sandy over loamy, mixed, mesic Aquic Haplustolls
Loretto	Fine-loamy, mixed, mesic Udic Argiustolls
Loup	Sandy, mixed, mesic Typic Haplaquolls
Marlake	Sandy, mixed, mesic Mollic Fluvaquents
*Nimbro	Fine-loamy, mixed (calcareous), mesic Mollic Ustifluvents
Ord	Coarse-loamy over sandy or sandy-skeletal, mesic Aeric Calciaquolls
Selia	Sandy, mixed, mesic Typic Natraqualfs
Tryon	Mixed, mesic Typic Psammaquents
Uly	Fine-silty, mixed, mesic Typic Haplustolls
Valentine	Mixed, mesic Typic Ustipsamments

Interpretive Groups

INTERPRETIVE GROUPS

[Dashes indicate that the soil was not placed in the interpretive group]

Soil name and map symbol	Land capability* N	Land capability* I	Prime farmland*	Range site	Windbreak suitability group
An---------------------------- Anselmo	IIe-3	IIe-8	Yes	Sandy----------------	5
AnC--------------------------- Anselmo	IIIe-3	IIIe-8	Yes	Sandy----------------	5
Bg----------------------------	VIIe-5	---	---		
Blownout land----------------				---	10
Valentine--------------------				Sands----------------	10
BsB--------------------------- Boelus	IIIe-6	IIIe-10	---	Sandy----------------	5
BsC--------------------------- Boelus	IVe-6	IIIe-10	---	Sandy----------------	5
CoD2-------------------------- Coly	IVe-9	IVe-6	---	Limy Upland----------	8
CoF--------------------------- Coly	VIe-9	---	---	Limy Upland----------	10
CpG---------------------------	VIIe-9	---	---		
Coly-------------------------				Thin Loess-----------	10
Hobbs------------------------				Silty Overflow-------	10
CuE2--------------------------	VIe-9	---	---		
Coly-------------------------				Limy Upland----------	8
Uly--------------------------				Silty----------------	3
DuB--------------------------- Dunday	IVe-5	IIIe-11	---	Sandy----------------	5
DuC--------------------------- Dunday	IVe-5	IVe-11	---	Sandy----------------	5
Eb---------------------------- Els	IVw-5	IVw-11	---	Subirrigated---------	2S
EfB---------------------------	VIe-5	IVe-12	---		
Els--------------------------				Subirrigated---------	2S
Ipage------------------------				Sandy Lowland--------	7
Em---------------------------- Elsmere	IVw-5	IVw-11	---	Subirrigated---------	2S
EnB---------------------------	IVe-5	IVe-11	---		
Elsmere----------------------				Subirrigated---------	2S
Ipage------------------------				Sandy Lowland--------	5
Ep----------------------------	Vw-7	---	---		
Elsmere----------------------				Subirrigated---------	2S
Loup-------------------------				Wet Subirrigated-----	2D
Eu----------------------------	VIs-1	IVs-11	---		
Elsmere----------------------				Subirrigated---------	2S
Selia------------------------				Saline Subirrigated--	10
Fu---------------------------- Fluvaquents	VIIIw-7	---	---	---	10

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability* N	Land capability* I	Prime farmland*	Range site	Windbreak suitability group
GfB-------------------------- Gates	IIe-9	IIe-6	Yes	Silty----------------	3
GfC-------------------------- Gates	IIIe-9	IIIe-6	---	Silty----------------	3
GfD-------------------------- Gates	IVe-9	IVe-6	---	Silty----------------	3
Gk--------------------------- Gibbon	IIw-4	IIw-6	Yes**	Subirrigated---------	2S
HaB-------------------------- Hall	IIe-1	IIe-4	Yes	Silty----------------	3
HeB-------------------------- Hersh	IIIe-3	IIe-8	Yes	Sandy----------------	5
Hk--------------------------- Hobbs	IIw-3	IIw-6	Yes	Silty Overflow-------	1
HtB-------------------------- Hord	IIe-1	IIe-6	Yes	Silty Lowland--------	1
IfB-------------------------- Ipage	VIe-5	IVe-12	---	Sandy Lowland--------	7
IgB-------------------------- Ipage	IVe-5	IVe-11	---	Sandy Lowland--------	5
LfB-------------------------- Libory	IIIe-6	IIIe-10	---	Sandy Lowland--------	5
Ln--------------------------- Loretto	IIc-1	I	Yes	Silty----------------	3
Lo--------------------------- Loup	Vw-7	---	---	Wet Subirrigated-----	2D
Lr--------------------------- Loup	Vw-7	---	---	Wetland--------------	10
Ma--------------------------- Marlake	VIIIw-7	---	---	---	10
Nb--------------------------- Nimbro	IIc-1	I	Yes	Silty Lowland--------	1L
Or--------------------------- Ord	IIw-4	IIw-8	Yes**	Subirrigated---------	2S
Tn--------------------------- Tryon	Vw-7	---	---	Wet Subirrigated-----	2D
Tp--------------------------- Tryon	Vw-7	---	---	Wetland--------------	10
Ts---------------------------	VIw-7	---	---		
Tryon-----------------------				Wet Subirrigated-----	10
Inavale---------------------				Sandy Lowland--------	10
UbC-------------------------- Uly	IIIe-1	IIIe-6	Yes	Silty----------------	3

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability* N	Land capability* I	Prime farmland*	Range site	Windbreak suitability group
UbD2------------------------- Uly	IVe-8	IVe-6	---	Silty----------------	3
VaB-------------------------- Valentine	VIe-5	IVe-12	---	Sandy----------------	7
VaD-------------------------- Valentine	VIe-5	IVe-12	---	Sands----------------	7
VaE-------------------------- Valentine	VIe-5	---	---	Sands----------------	7
VaF--------------------------	VIIe-5	---	---		
Valentine, rolling----------				Sands----------------	10
Valentine, hilly------------				Choppy Sands---------	10
VeB-------------------------- Valentine	IVe-5	IVe-11	---	Sandy----------------	5
VfD--------------------------	VIe-5	IVe-11	---		
Valentine-------------------				Sands----------------	7
Dunday----------------------				Sandy----------------	5
VmD--------------------------	VIe-5	IVe-12	---		
Valentine-------------------				Sands----------------	7
Els-------------------------				Subirrigated---------	2S

* A soil complex is treated as a single management unit in the land capability and prime farmland columns. The N column is for nonirrigated soils; the I column is for irrigated soils.
** Where drained.

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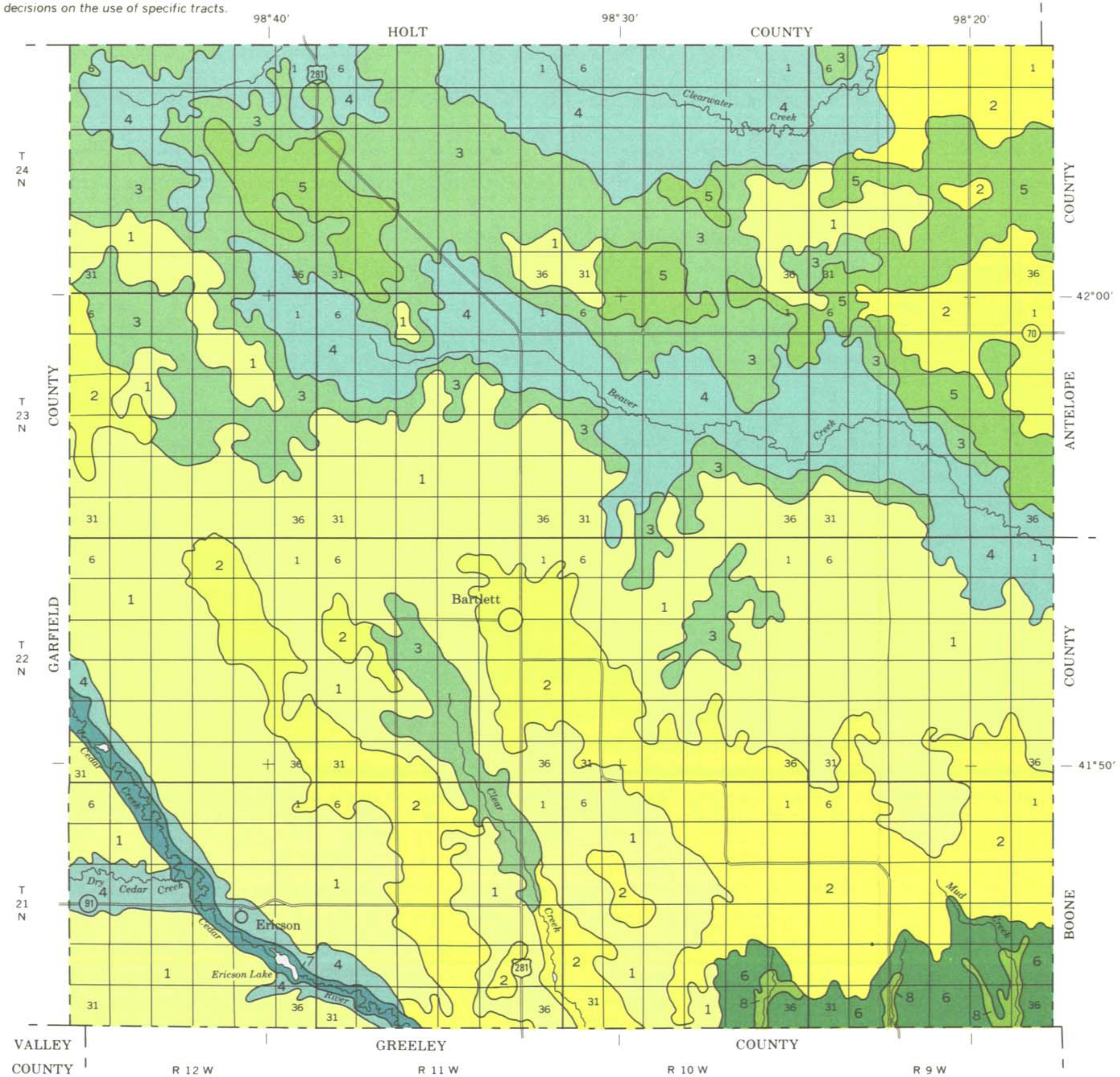
NRCS Accessibility Statement

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



LEGEND*

1	VALENTINE association: Deep, gently sloping to very steep, excessively drained, sandy soils formed in eolian sand; on upland sandhills
2	DUNDAY-VALENTINE-BOELUS association: Deep, nearly level to strongly sloping, well drained and excessively drained, sandy soils formed in eolian sand and in eolian sand over loamy and silty sediments; on uplands and stream terraces
3	ELS-VALENTINE-IPAGE association: Deep, nearly level to strongly sloping, somewhat poorly drained, excessively drained, and moderately well drained, sandy soils formed in eolian and alluvial sands; in sandhill valleys and on uplands
4	ELSMERE-LOUP-IPAGE association: Deep, nearly level and very gently sloping, moderately well drained to very poorly drained, sandy and loamy soils formed in eolian and alluvial sands; on bottom land, on stream terraces, and in sandhill valleys
5	VALENTINE-ELS association: Deep, nearly level to rolling, excessively drained and somewhat poorly drained, sandy soils formed in eolian and alluvial sands; on uplands and in sandhill valleys
6	COLY-ULY association: Deep, gently sloping to very steep, well drained to excessively drained, silty soils formed in loess; on uplands
7	FLUVAQUENTS-LOUP-ELSMERE association: Deep, nearly level, somewhat poorly drained to very poorly drained, sandy and loamy soils formed in sandy alluvium and mixed eolian and alluvial sands; on bottom land
8	HOBBS-HORD association: Deep, nearly level and very gently sloping, well drained, silty soils formed in silty alluvium; on stream terraces, on bottom land, and in upland drainageways

*The texture terms in the descriptive headings refer to the surface layer of the major soils in each association.

COMPILED 1985

N

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP

WHEELER COUNTY, NEBRASKA

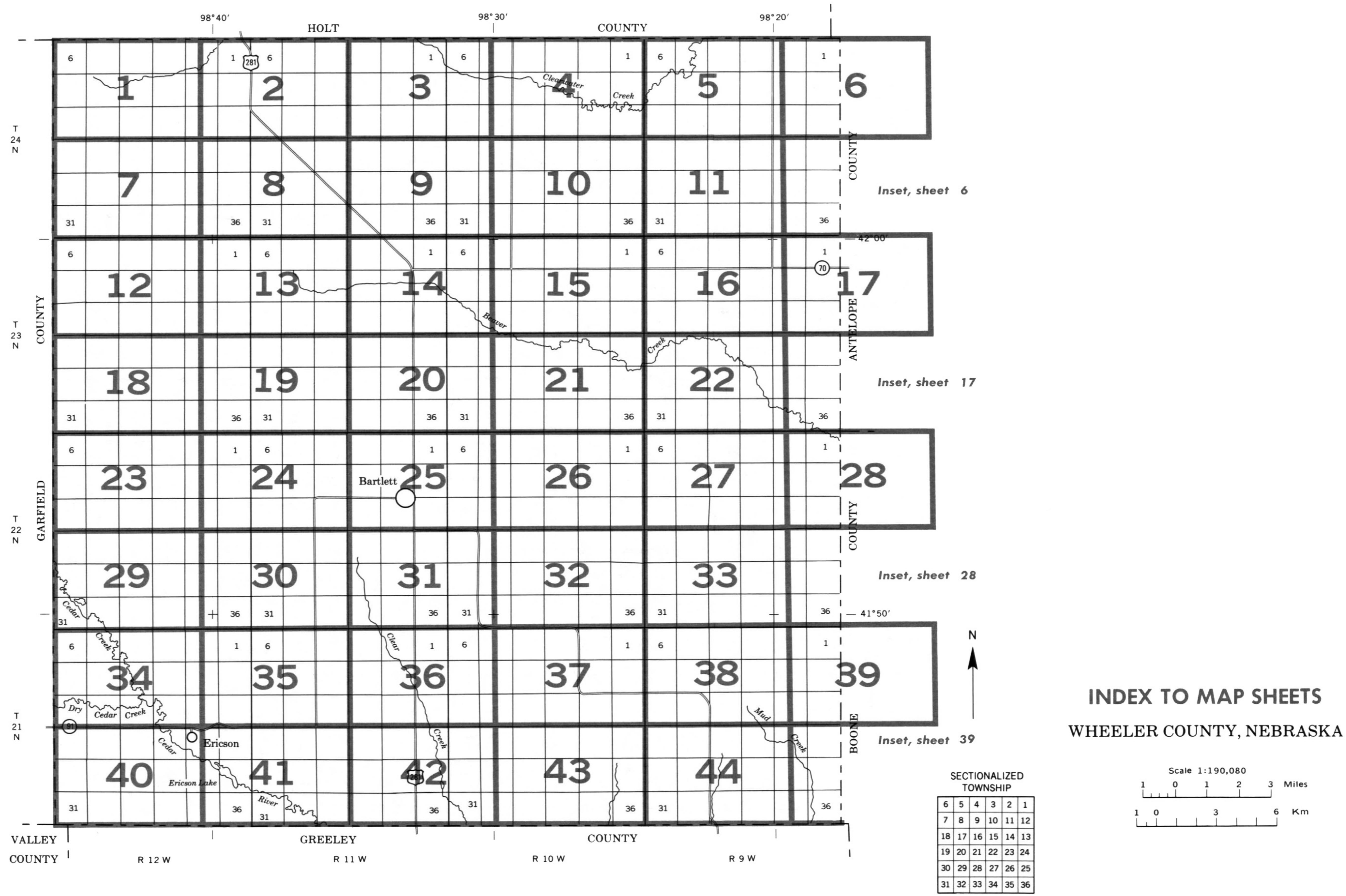
SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 6 Km



6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

WHEELER COUNTY, NEBRASKA

SOIL LEGEND

Map symbols consist of a combination of letters or of letters and a number. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 indicates that the soil is eroded.

SYMBOL	NAME
An	Anselmo fine sandy loam, 0 to 2 percent slopes
AnC	Anselmo fine sandy loam, 2 to 6 percent slopes
Bg	Blownout land-Valentine complex, 6 to 60 percent slopes
BsB	Boelus loamy sand, 0 to 3 percent slopes
BsC	Boelus loamy sand, 3 to 6 percent slopes
CoD2	Coly silt loam, 6 to 11 percent slopes, eroded
CoF	Coly silt loam, 17 to 30 percent slopes
CpG	Coly-Hobbs silt loams, 2 to 60 percent slopes
CuE2	Coly-Uly silt loams, 11 to 17 percent slopes, eroded
DuB	Dunday loamy fine sand, 0 to 3 percent slopes
DuC	Dunday loamy fine sand, 3 to 6 percent slopes
Eb	Els loamy sand, 0 to 2 percent slopes
EfB	Els-Ipage fine sands, 0 to 3 percent slopes
Em	Elsmere loamy fine sand, 0 to 2 percent slopes
EnB	Elsmere-Ipage loamy fine sands, 0 to 3 percent slopes
Ep	Elsmere-Loup complex, 0 to 2 percent slopes
Eu	Elsmere-Selia loamy fine sands, 0 to 2 percent slopes
Fu	Fluvaquents, sandy
GfB	Gates very fine sandy loam, 0 to 3 percent slopes
GfC	Gates very fine sandy loam, 3 to 6 percent slopes
GfD	Gates very fine sandy loam, 6 to 11 percent slopes
Gk	Gibbon loam, 0 to 2 percent slopes
HaB	Hall silt loam, 1 to 3 percent slopes
HeB	Hersh fine sandy loam, 0 to 3 percent slopes
Hk	Hobbs silt loam, 0 to 2 percent slopes
HtB	Hord silt loam, terrace, 1 to 3 percent slopes
IfB	Ipage fine sand, 0 to 3 percent slopes
IgB	Ipage loamy sand, 0 to 3 percent slopes
LfB	Libory loamy fine sand, 0 to 3 percent slopes
Ln	Loretto loam, 0 to 2 percent slopes
Lo	Loup fine sandy loam, 0 to 2 percent slopes
Lr	Loup fine sandy loam, wet, 0 to 2 percent slopes
Ma	Marlake loamy fine sand, 0 to 2 percent slopes
Nb	Nimbro silt loam, 0 to 2 percent slopes
Or	Ord loam, 0 to 2 percent slopes
Tn	Tryon loamy fine sand, 0 to 2 percent slopes
Tp	Tryon loamy fine sand, wet, 0 to 2 percent slopes
Ts	Tryon-Inavale complex, channeled
UbC	Uly silt loam, 3 to 6 percent slopes
UbD2	Uly silt loam, 6 to 11 percent slopes, eroded
VaB	Valentine fine sand, 0 to 3 percent slopes
VaD	Valentine fine sand, 3 to 9 percent slopes
VaE	Valentine fine sand, rolling
VaF	Valentine fine sand, rolling and hilly
VeB	Valentine loamy fine sand, 0 to 3 percent slopes
VfD	Valentine-Dunday loamy fine sands, 3 to 9 percent slopes
VmD	Valentine-Els fine sands, 0 to 9 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

County

Field sheet matchline & neatline

AD HOC BOUNDARY (label)

Small airport, airfield, park or cemetery — Davis Airstrip

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

Other roads

Trail

ROAD EMBLEMS & DESIGNATIONS

Federal — 410

State — 52

DAMS

Medium or small — water, w

MISCELLANEOUS CULTURAL FEATURES

Farmstead, house (omit in urban areas)

Church

School

Located object (label) — Tower

Windmill

WATER FEATURES

DRAINAGE

Perennial, double line

Perennial, single line

Intermittent

Drainage end

Canals or ditches

Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

Perennial — water, w

MISCELLANEOUS WATER FEATURES

Marsh or swamp

Well, artesian

Well, irrigation

Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — VfD, VaE

ESCARPMENTS

Other than bedrock (points down slope)

SHORT STEEP SLOPE

MISCELLANEOUS

Blowout (up to 5 acres)

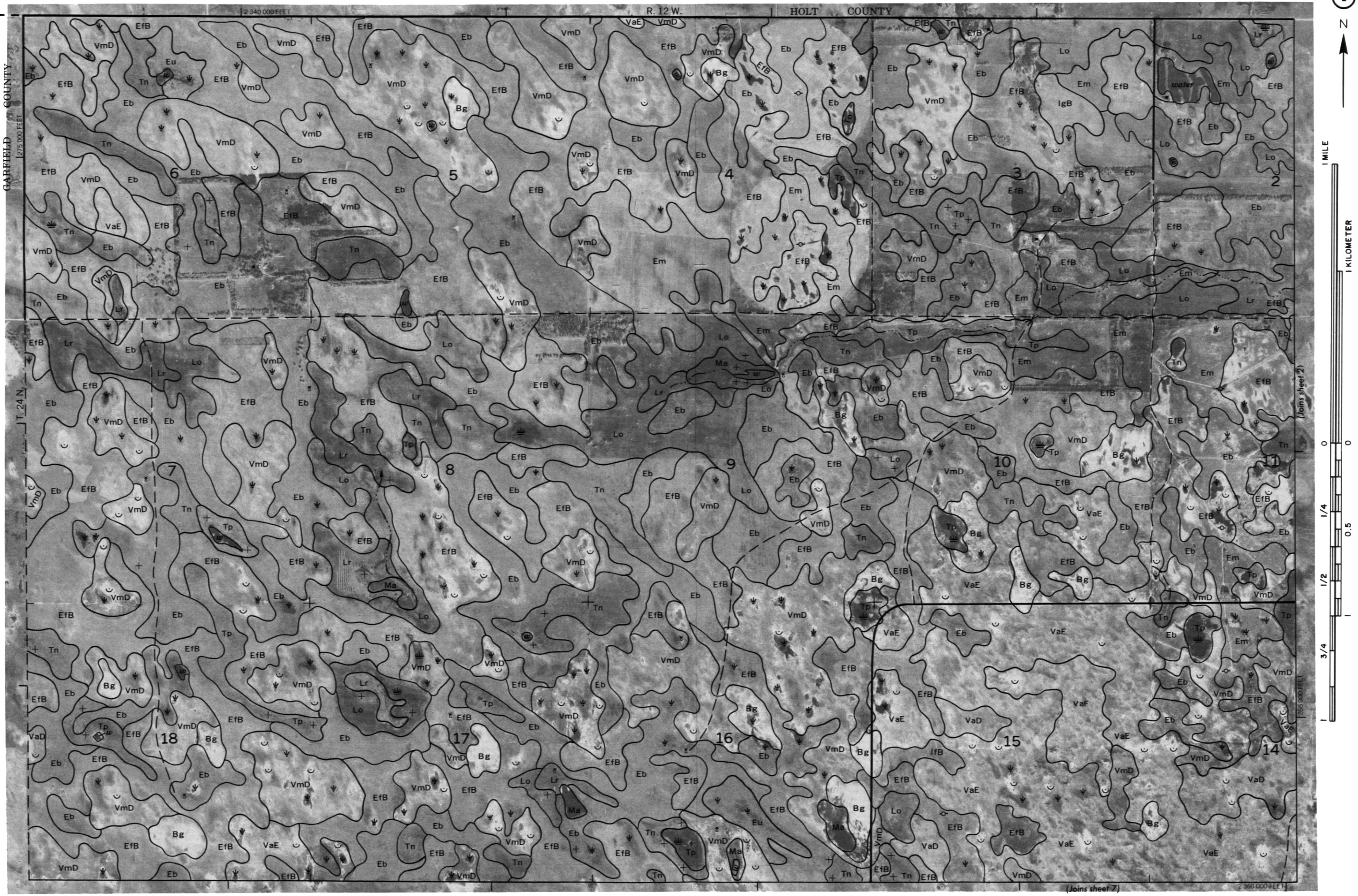
Saline spot (up to 3 acres)

Sandy spot

Severely eroded spot (up to 5 acres)

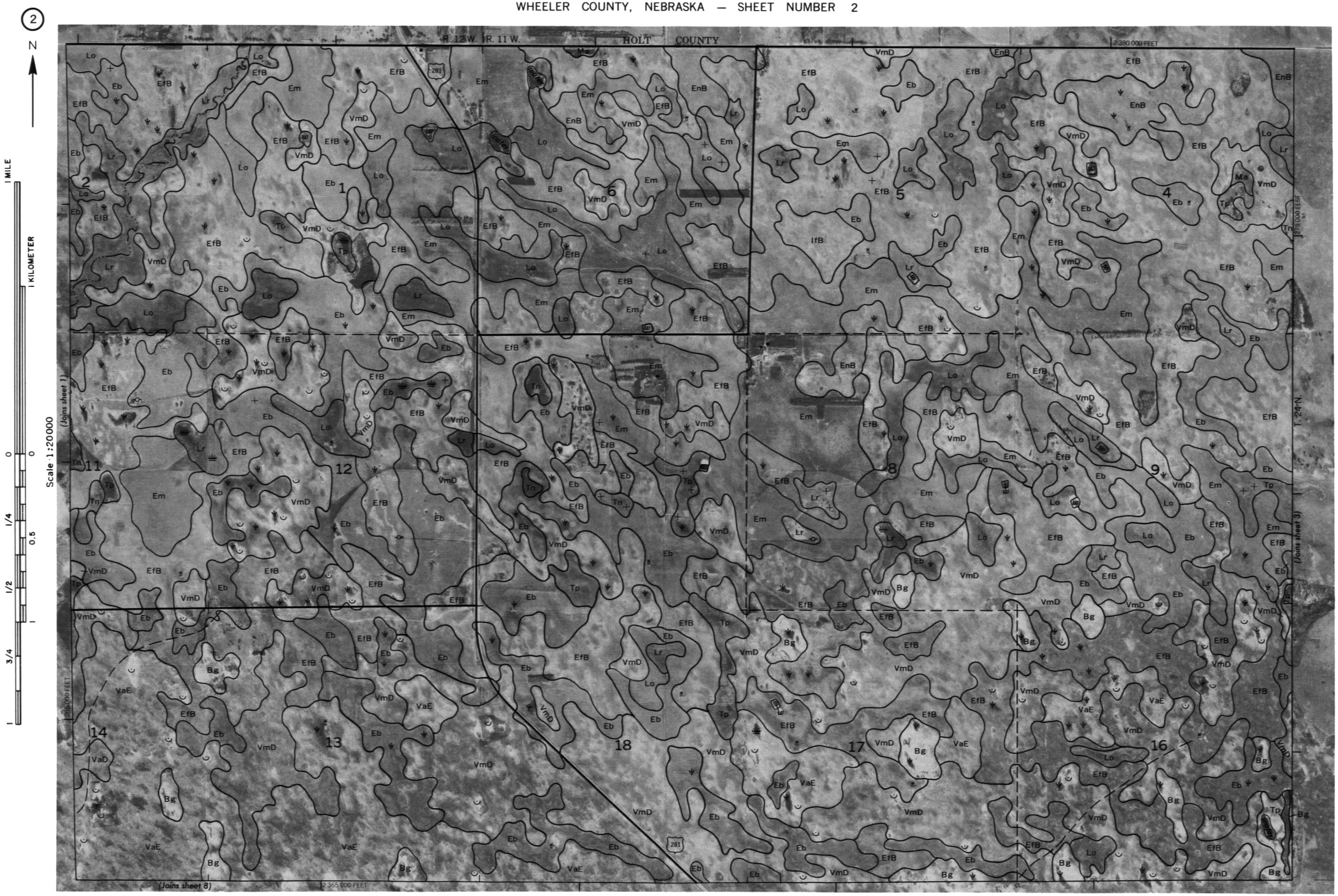
Borrow Pit

Silty Outcrop



WHEELER COUNTY, NEBRASKA NO. 1

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



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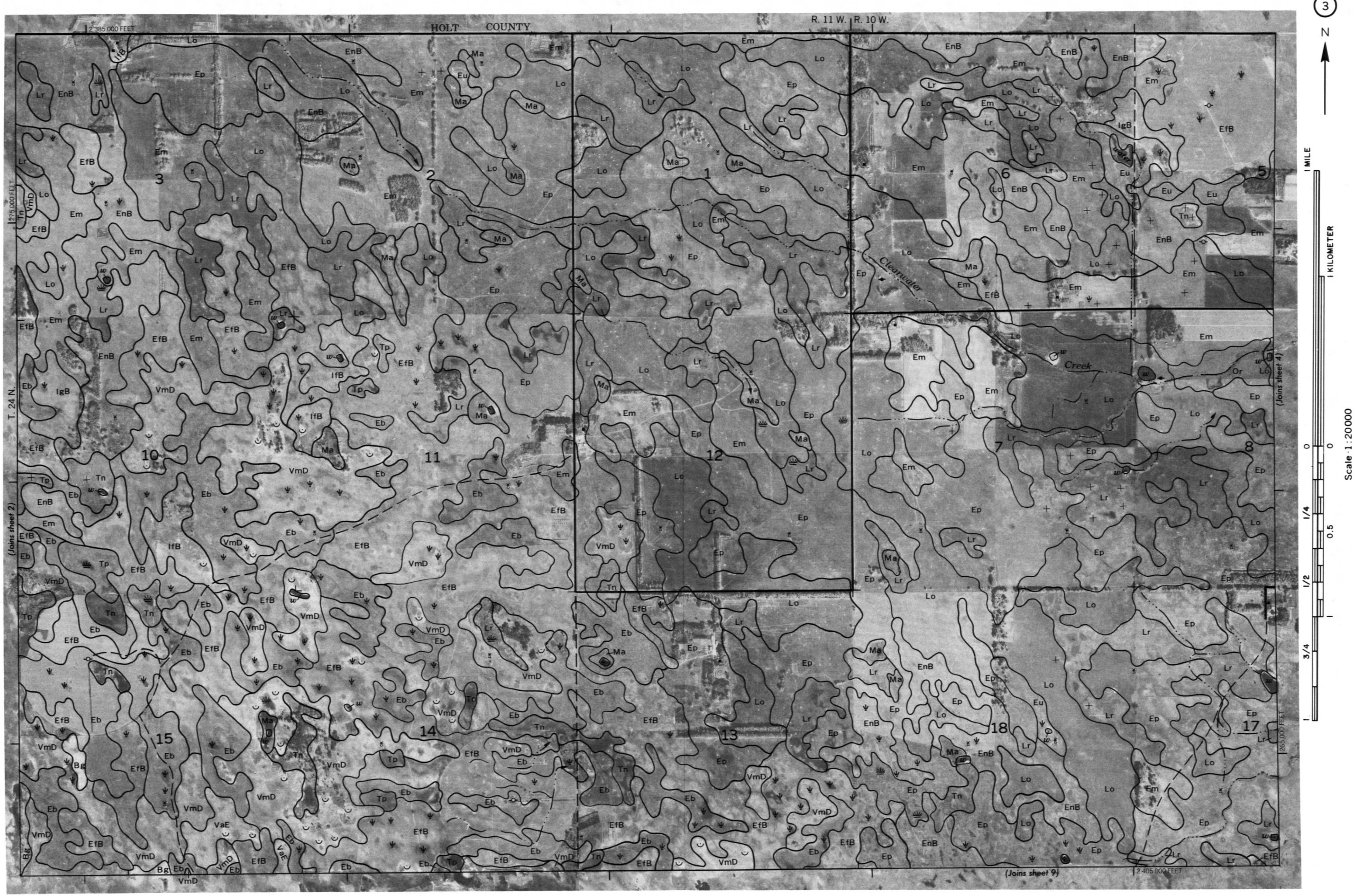
Coordinate grid ticks and land division corners, if shown, are approximately positioned



WHEELER COUNTY, NEBRASKA NO. 3

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4

N

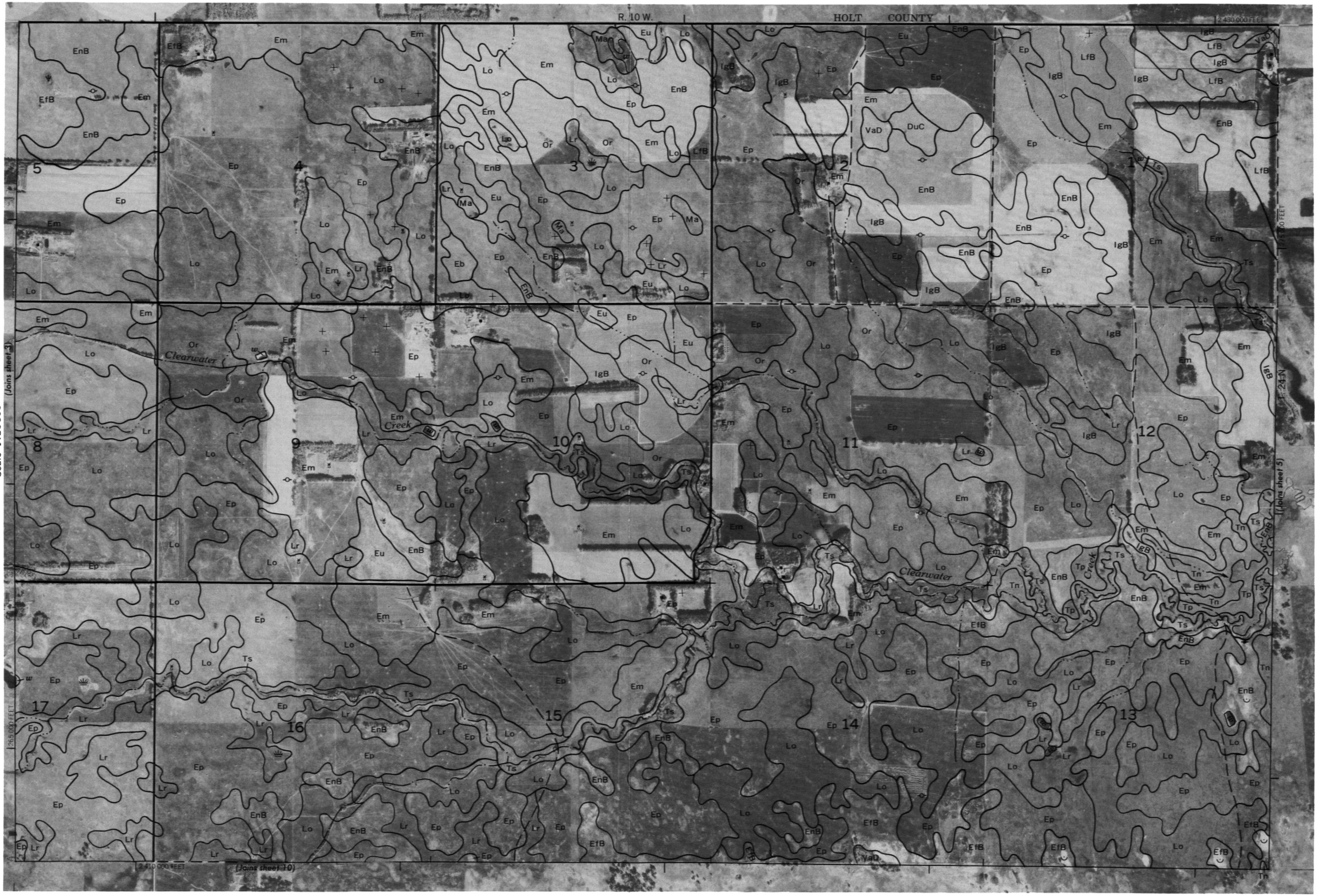
1 MILE

1 KILOMETER

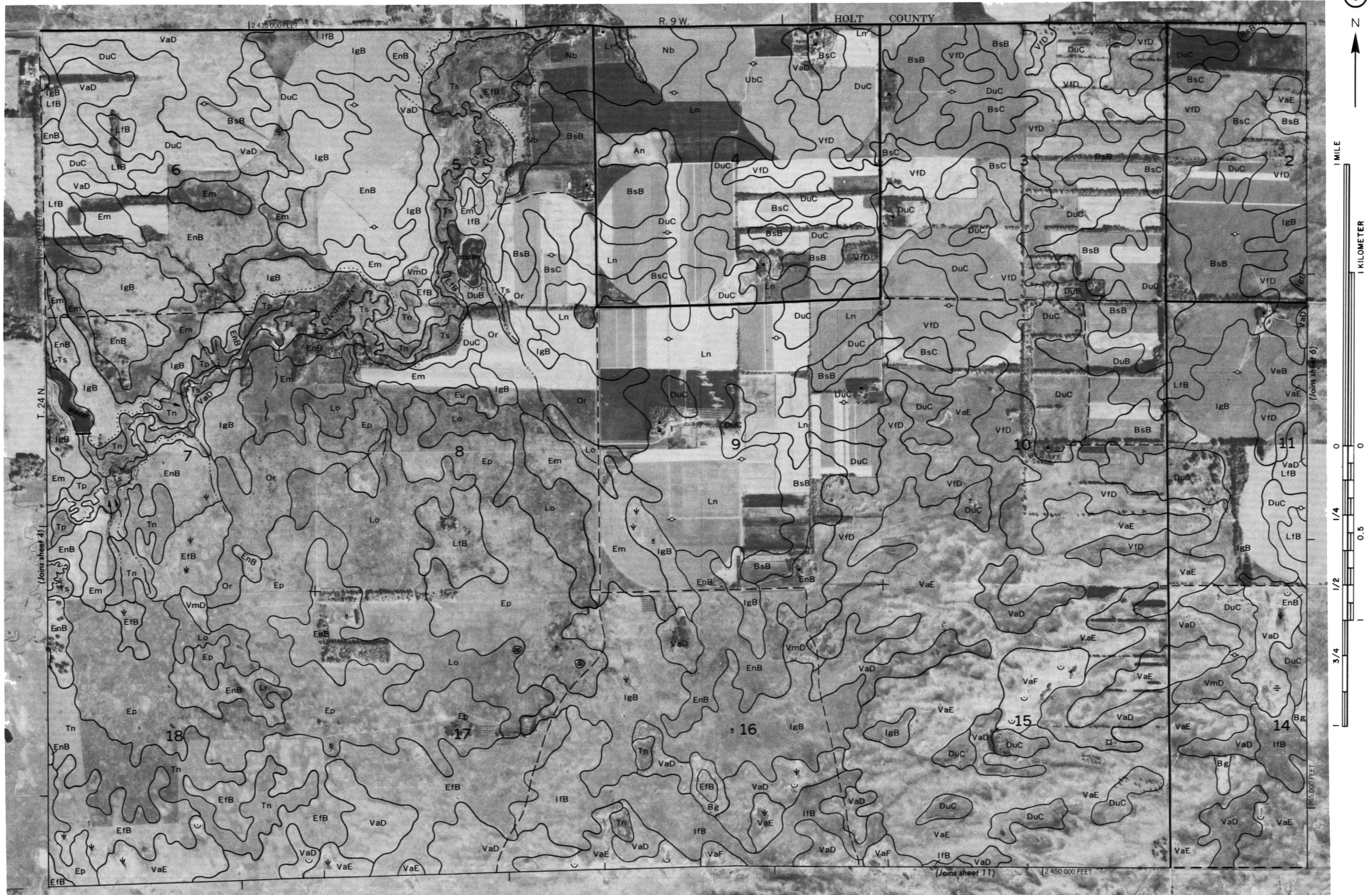
Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1

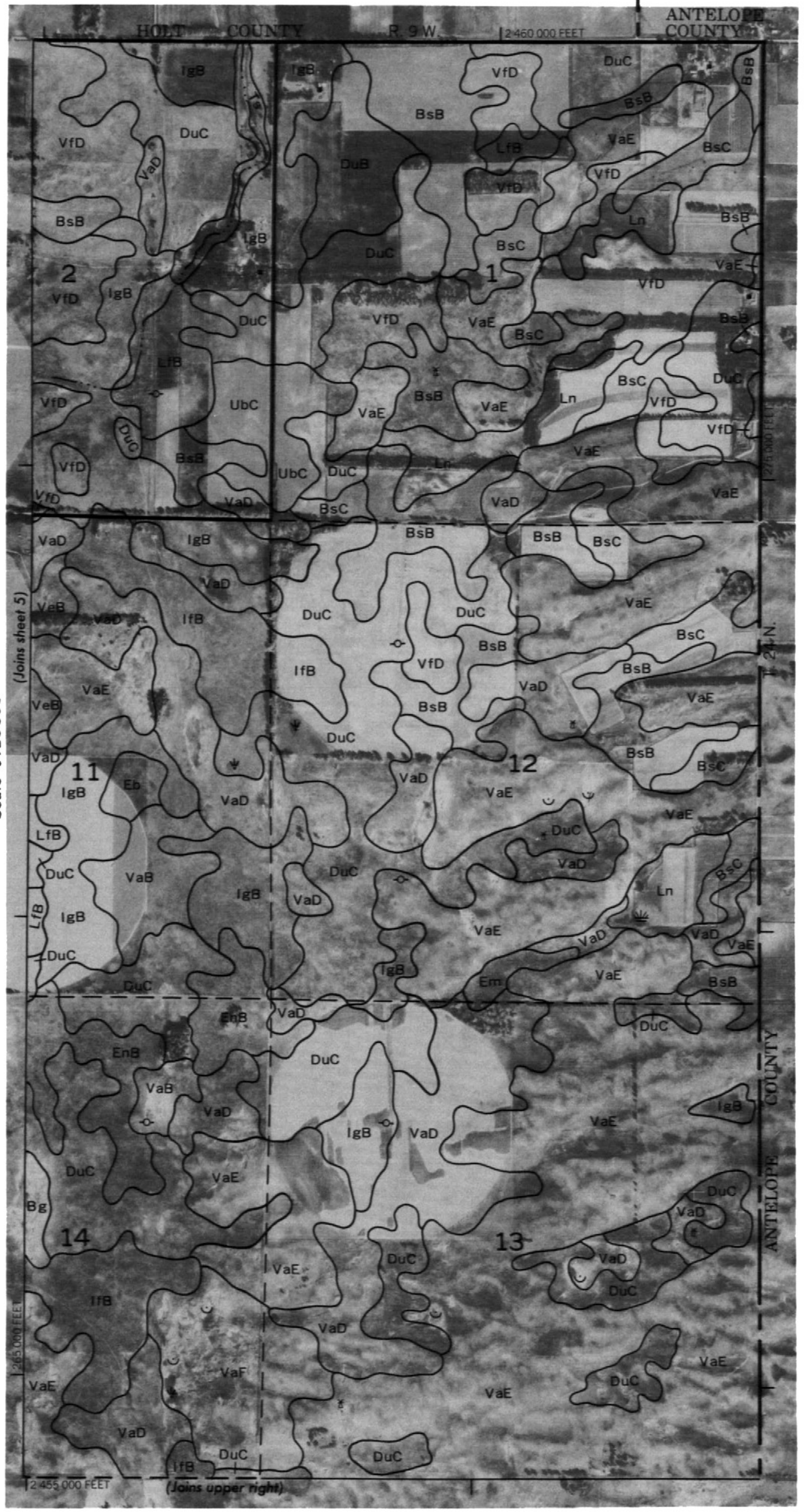


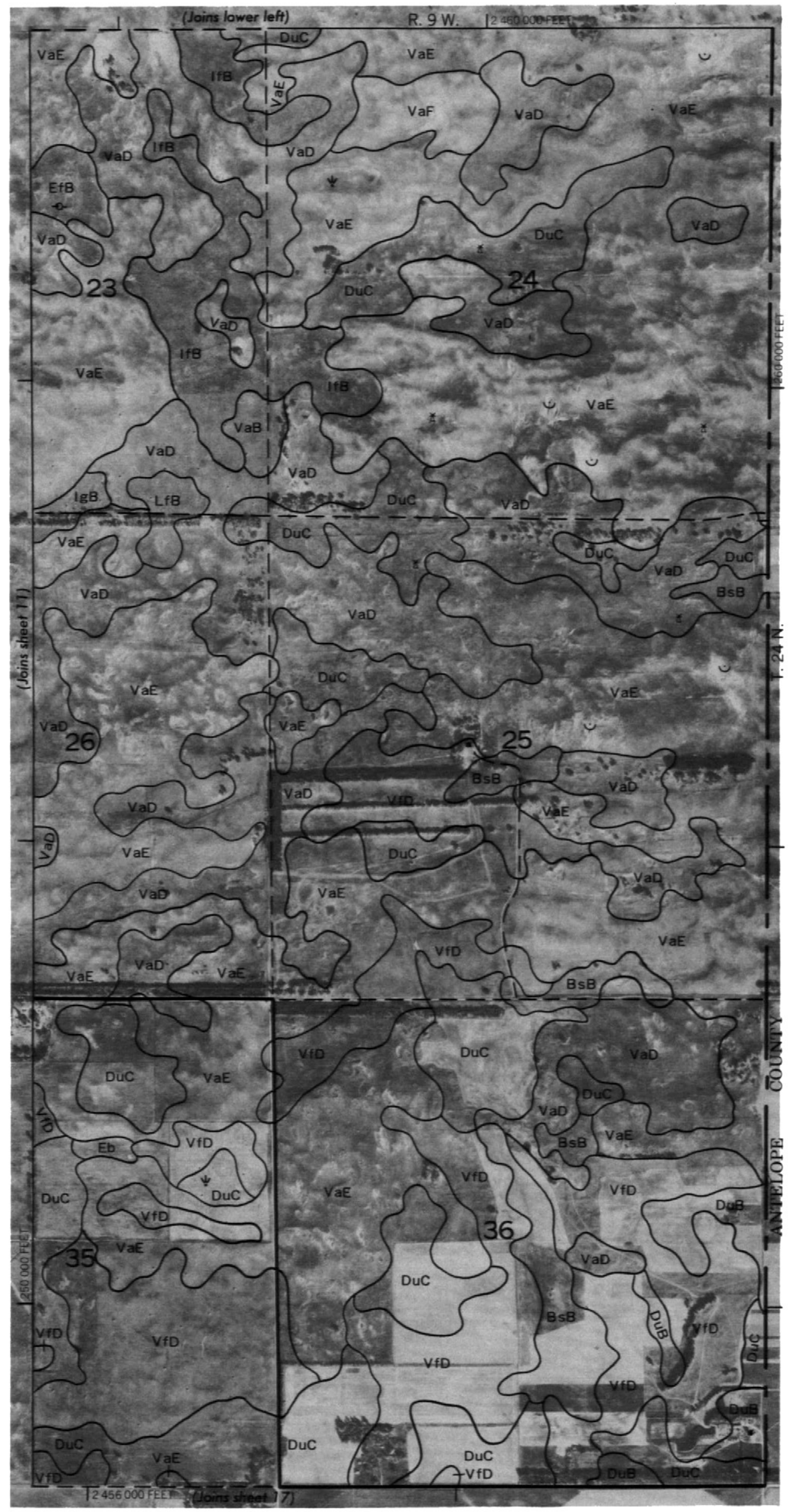
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



WHEELER COUNTY, NEBRASKA NO. 5

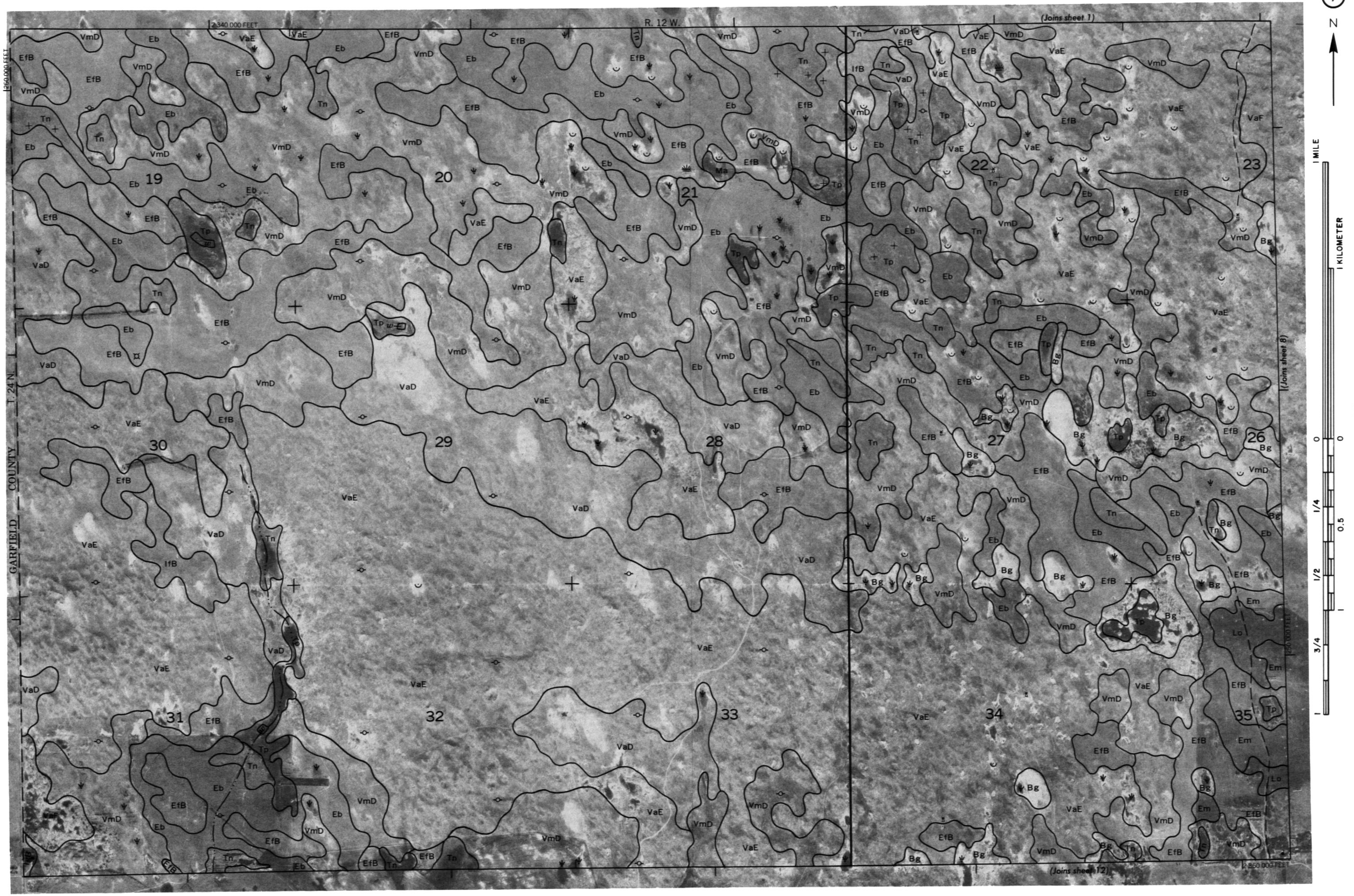
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





4000 AND 5000-FOOT GRID TICKS

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



WHEELER COUNTY, NEBRASKA NO. 7

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA — SHEET NUMBER 8

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

WHEELER COUNTY, NEBRASKA NO. 8

9

N

1 MILE

1 KILOMETER

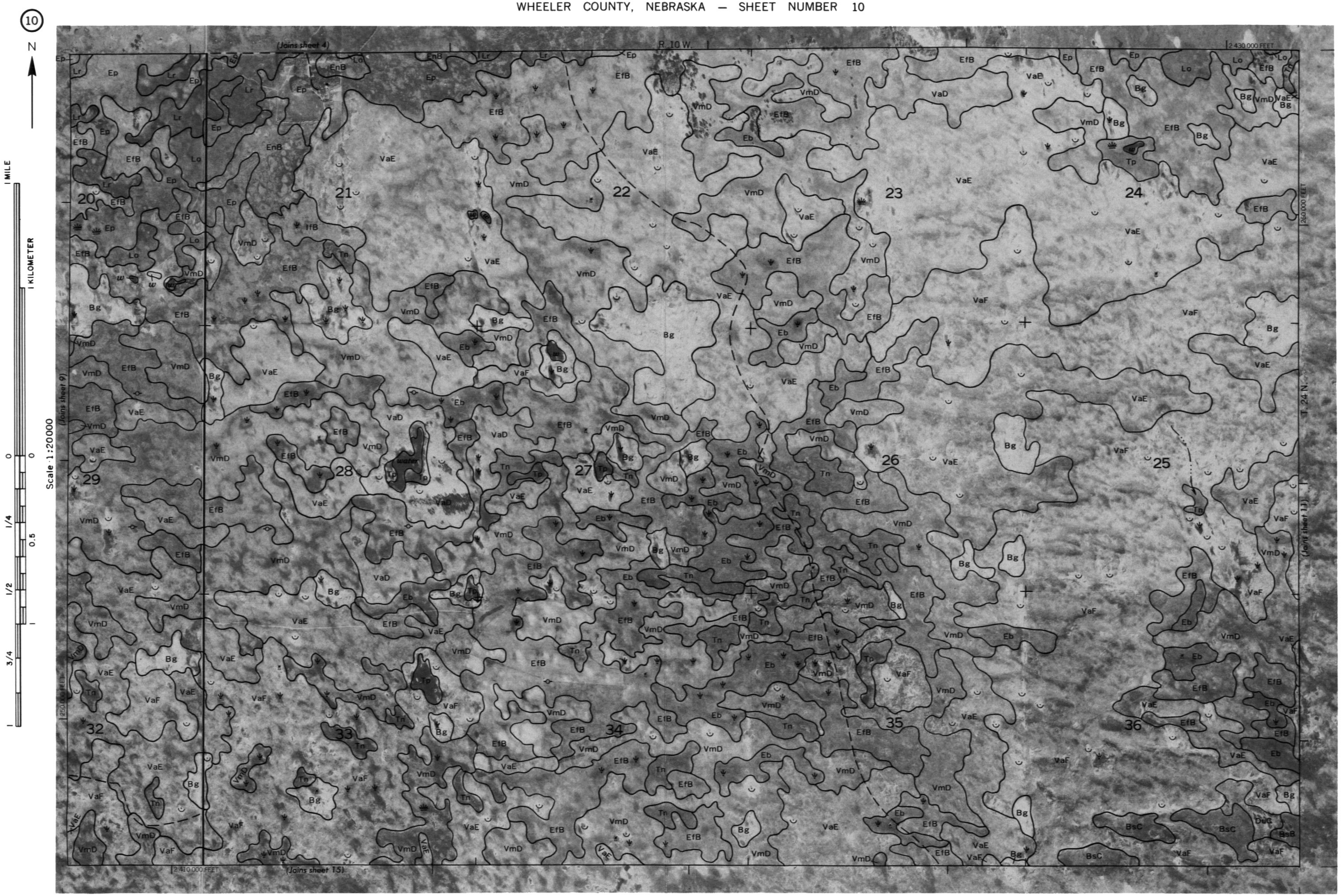
0 1/4 1/2 3/4

0 0.5

Scale 1:20000

WHEELER COUNTY, NEBRASKA NO. 9

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA NO. 11

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(12)

N

1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA NO. 12

13

N

1 MILE

1 KILOMETER

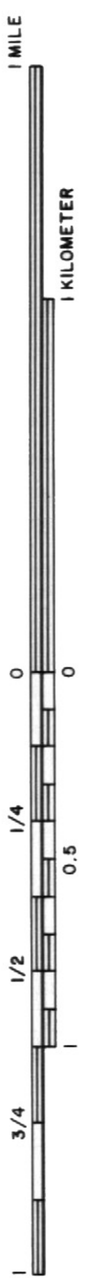
Scale 1:20000

WHEELER COUNTY, NEBRASKA NO. 13

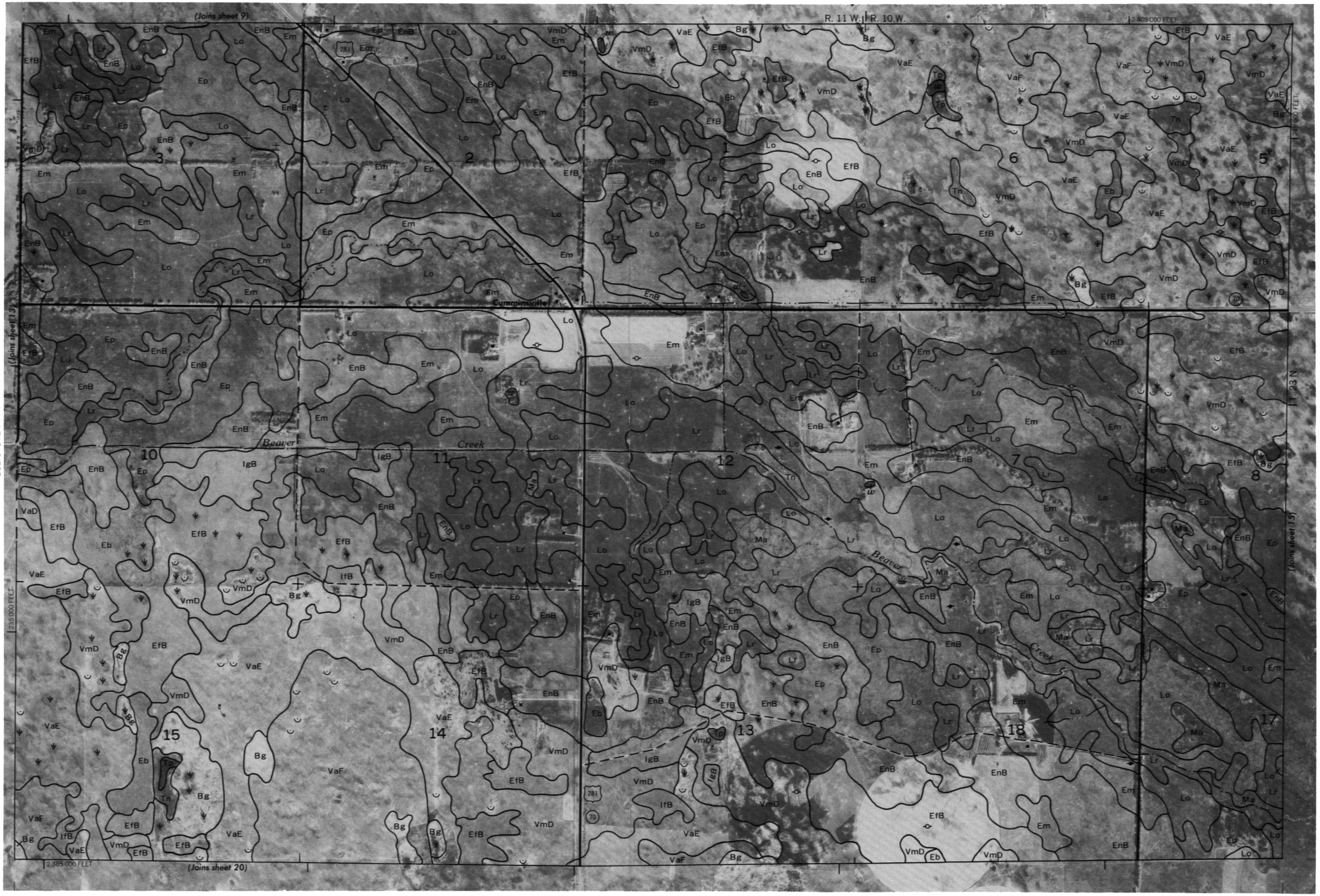
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

14

N

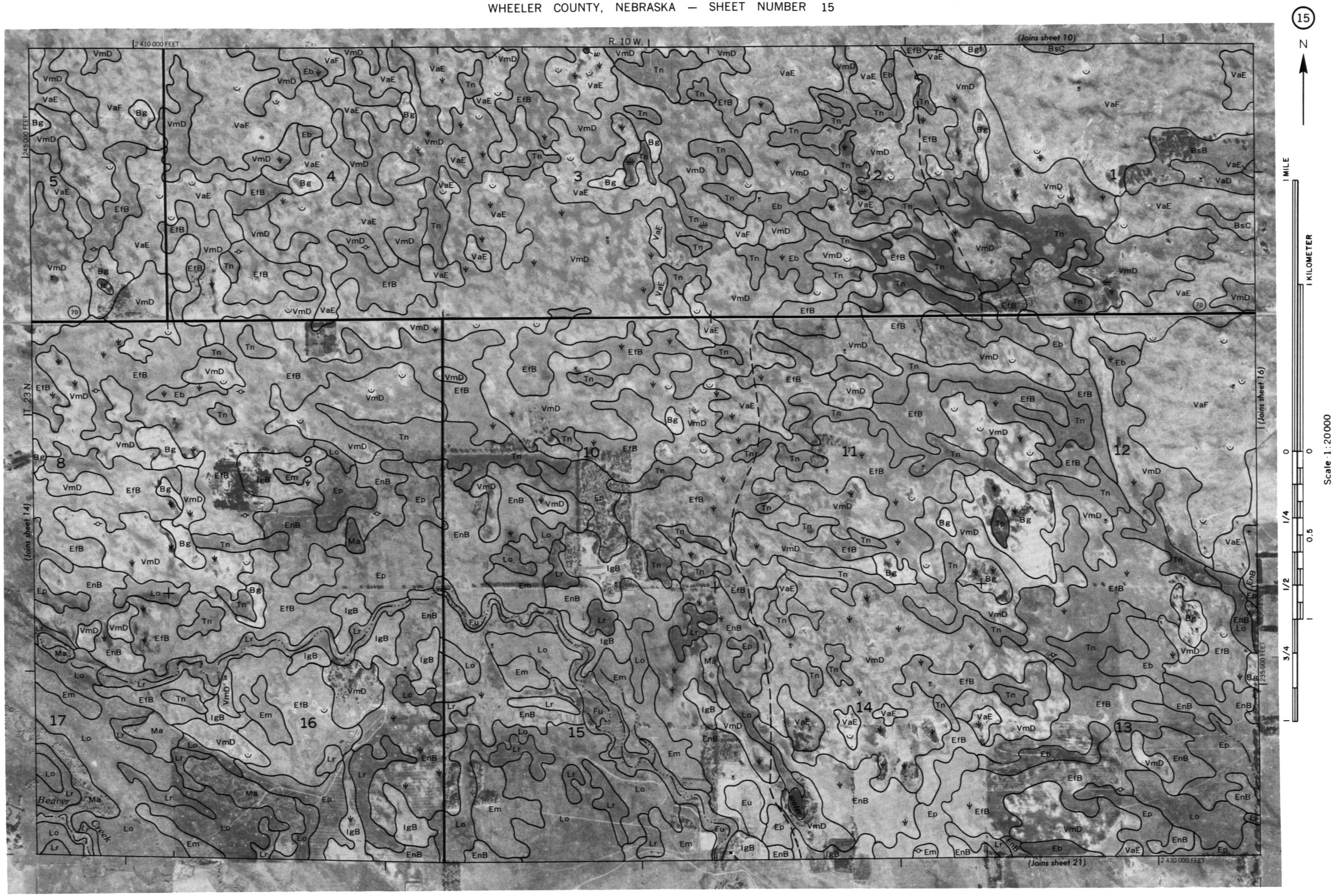


Scale 1:20000



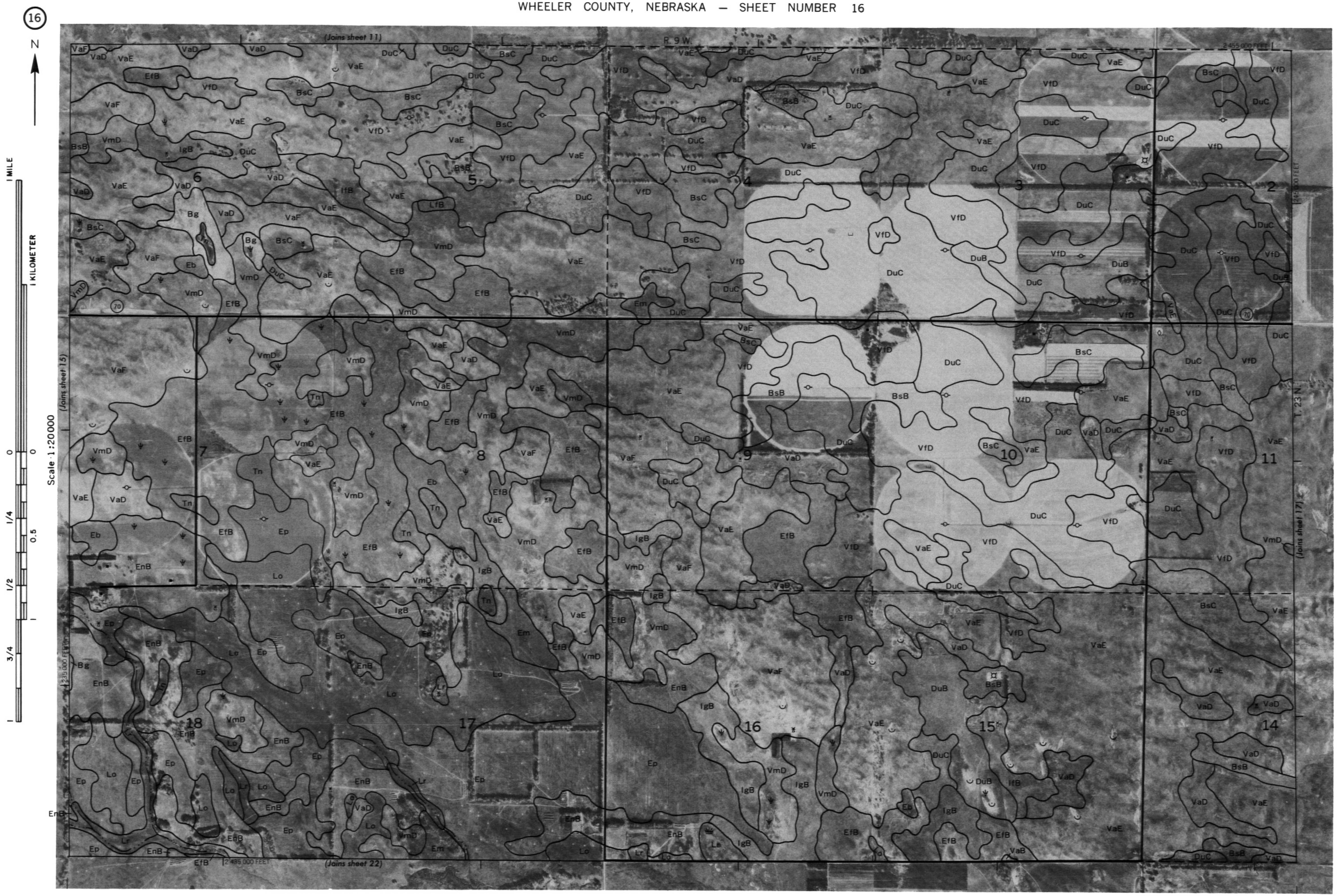
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA NO. 14



WHEELER COUNTY, NEBRASKA NO. 15

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

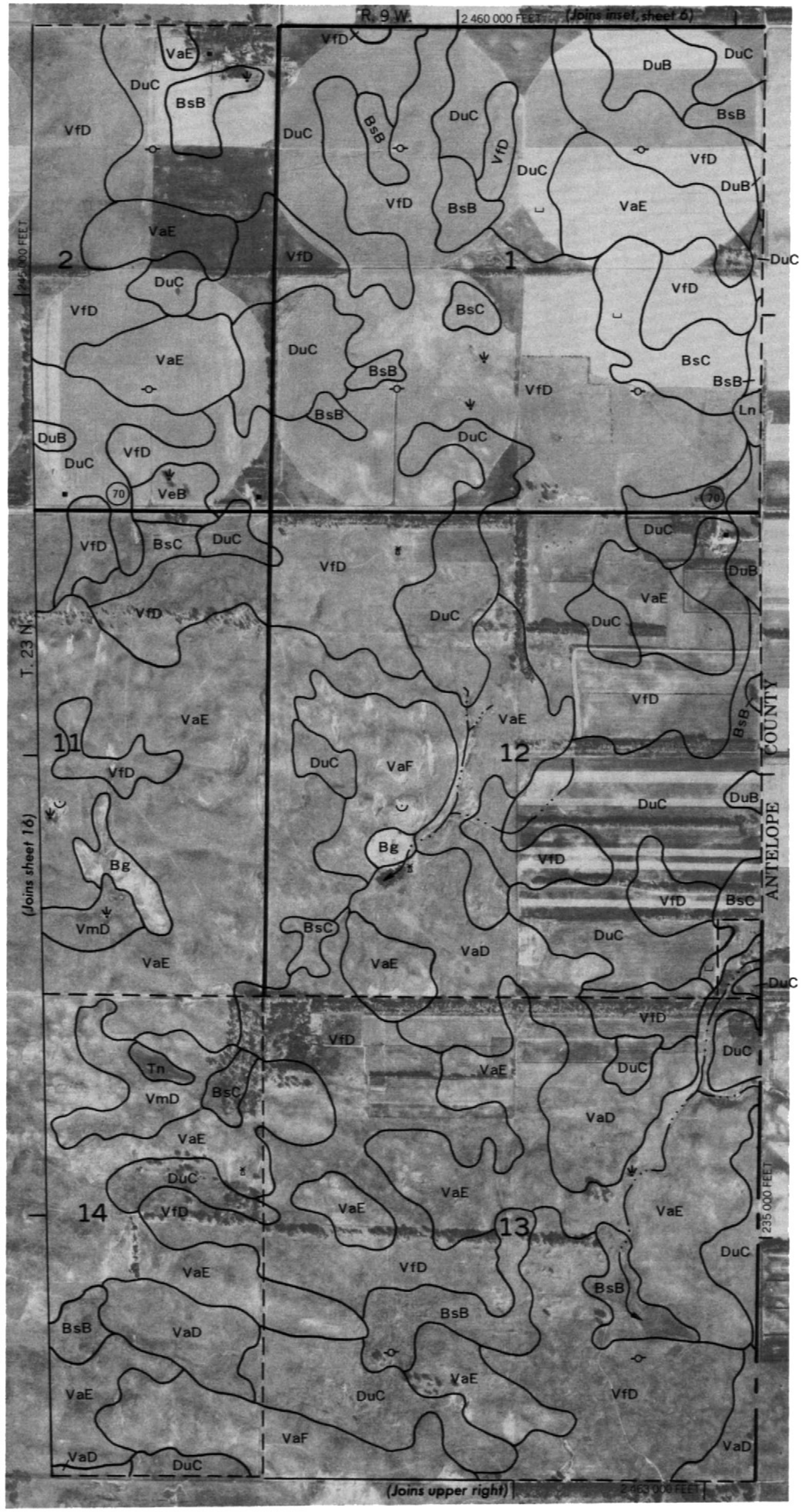
WHEELER COUNTY, NEBRASKA NO. 16

17

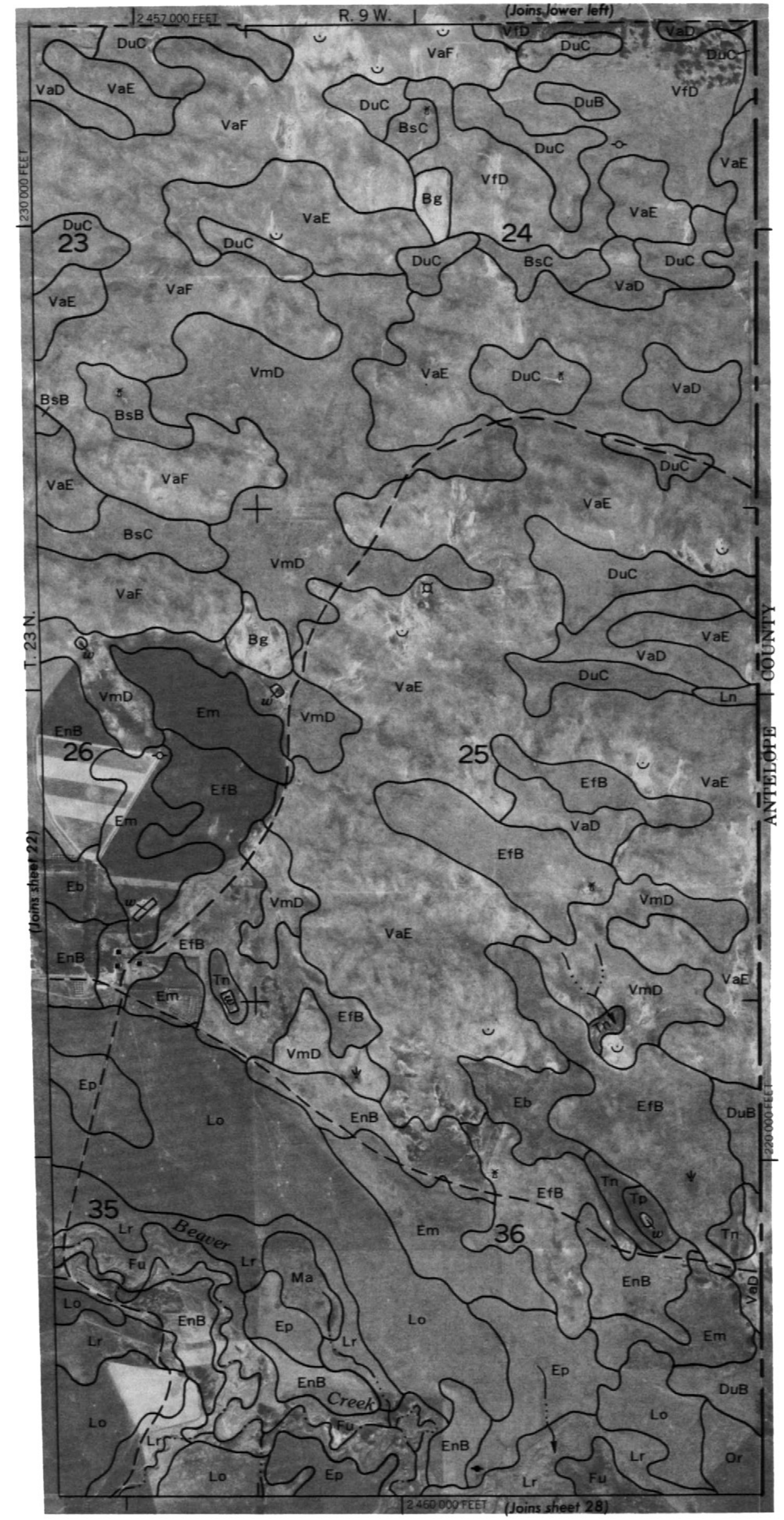
N

WHEELER COUNTY, NEBRASKA NO. 17

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



3000 AND 5000-FOOT GRID TICKS



3000 AND 5000-FOOT GRID TICKS

1 MILE

1 KILOMETER

0

1/4

1/2

3/4

1

0

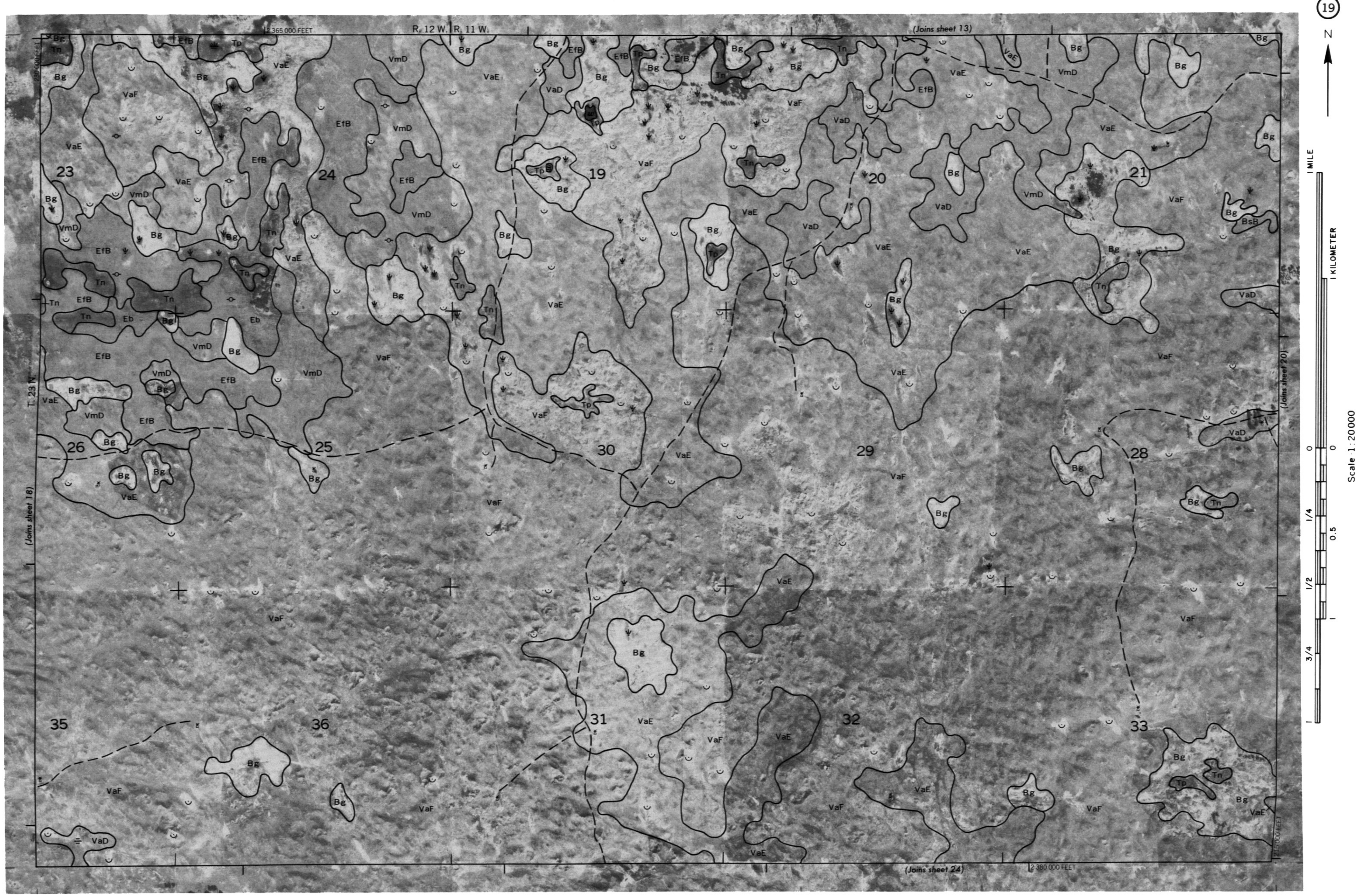
0.5

1

Scale 1 : 20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA NO. 18



WHEELER COUNTY, NEBRASKA NO. 19

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

20

N

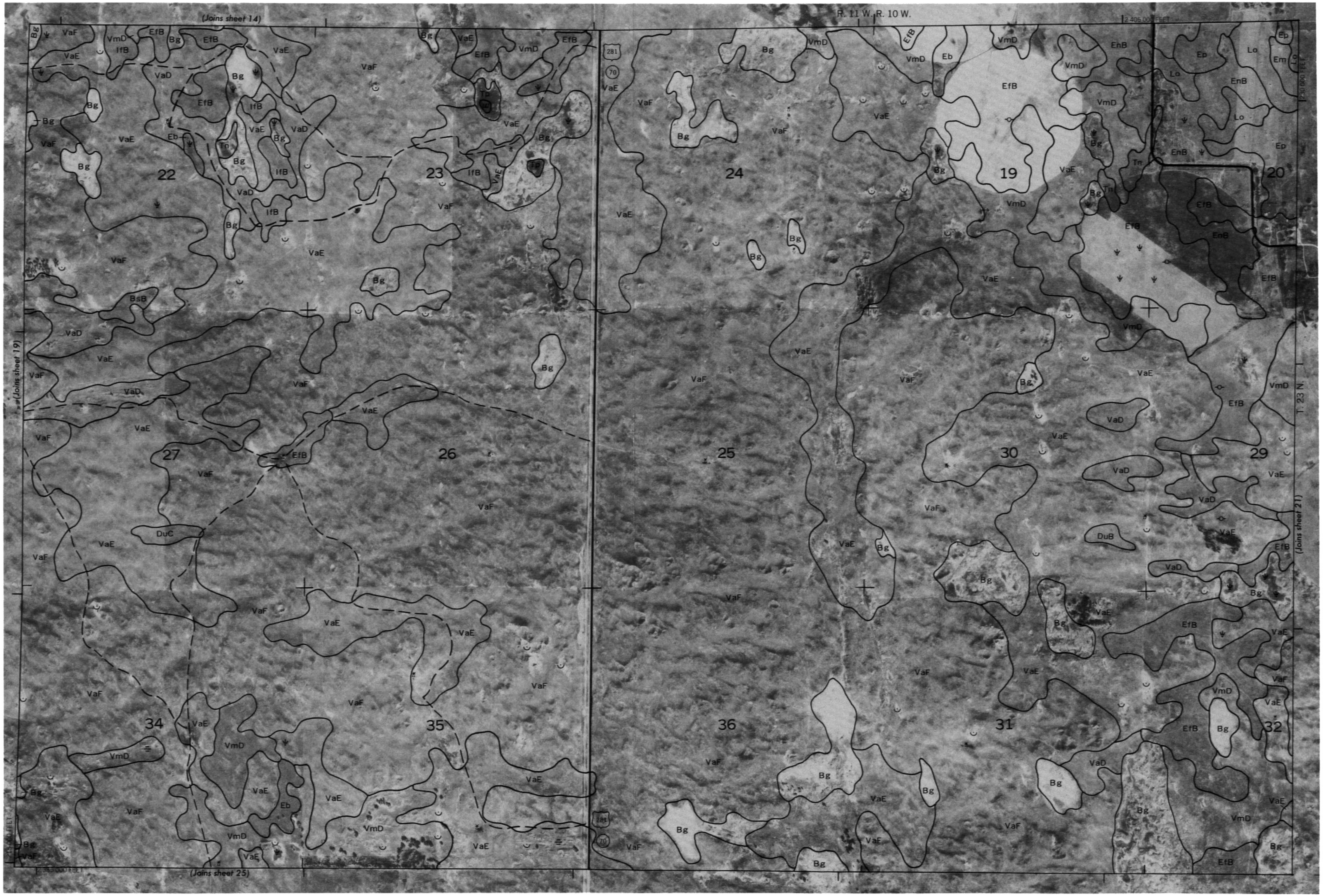
1 MILE

1 KILOMETER

Scale 1:20000

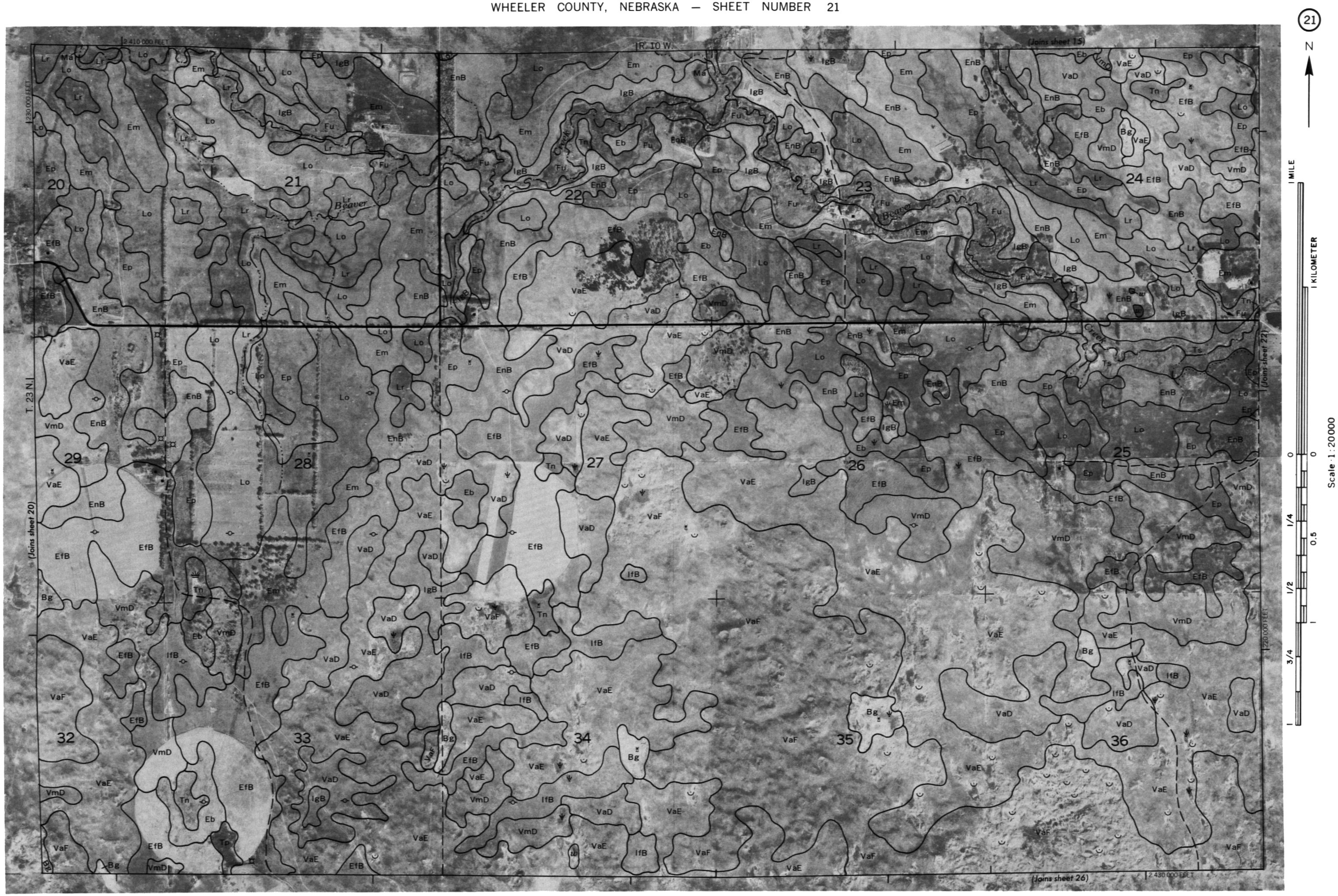
0 1/4 1/2 3/4 1

0 0.5 1



WHEELER COUNTY, NEBRASKA NO. 20

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



WHEELER COUNTY, NEBRASKA NO. 21

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

22

N

1 MILE

1 KILOMETER

Scale 1:20000

0 0

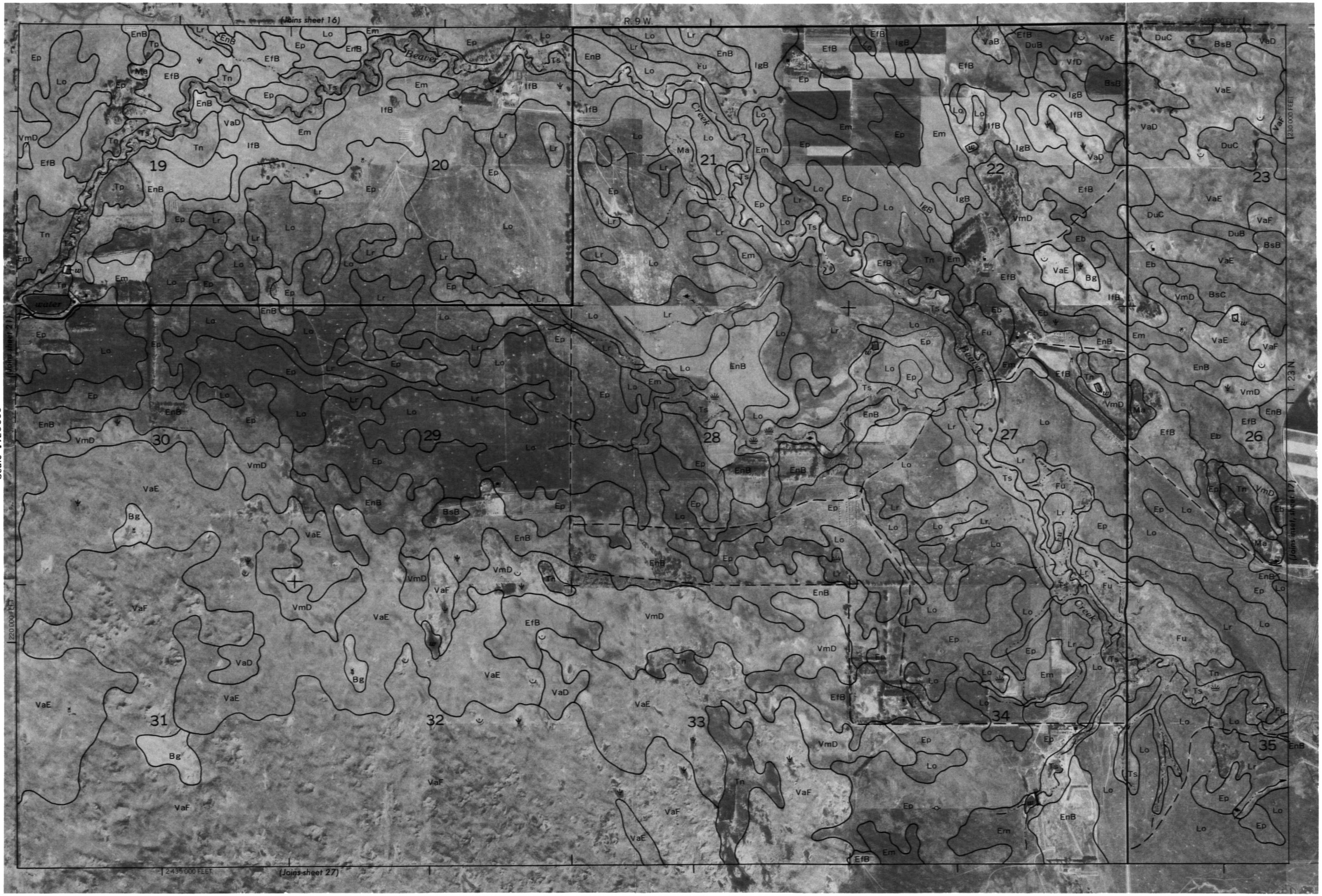
1/4

0.5

1/2

3/4

1 1

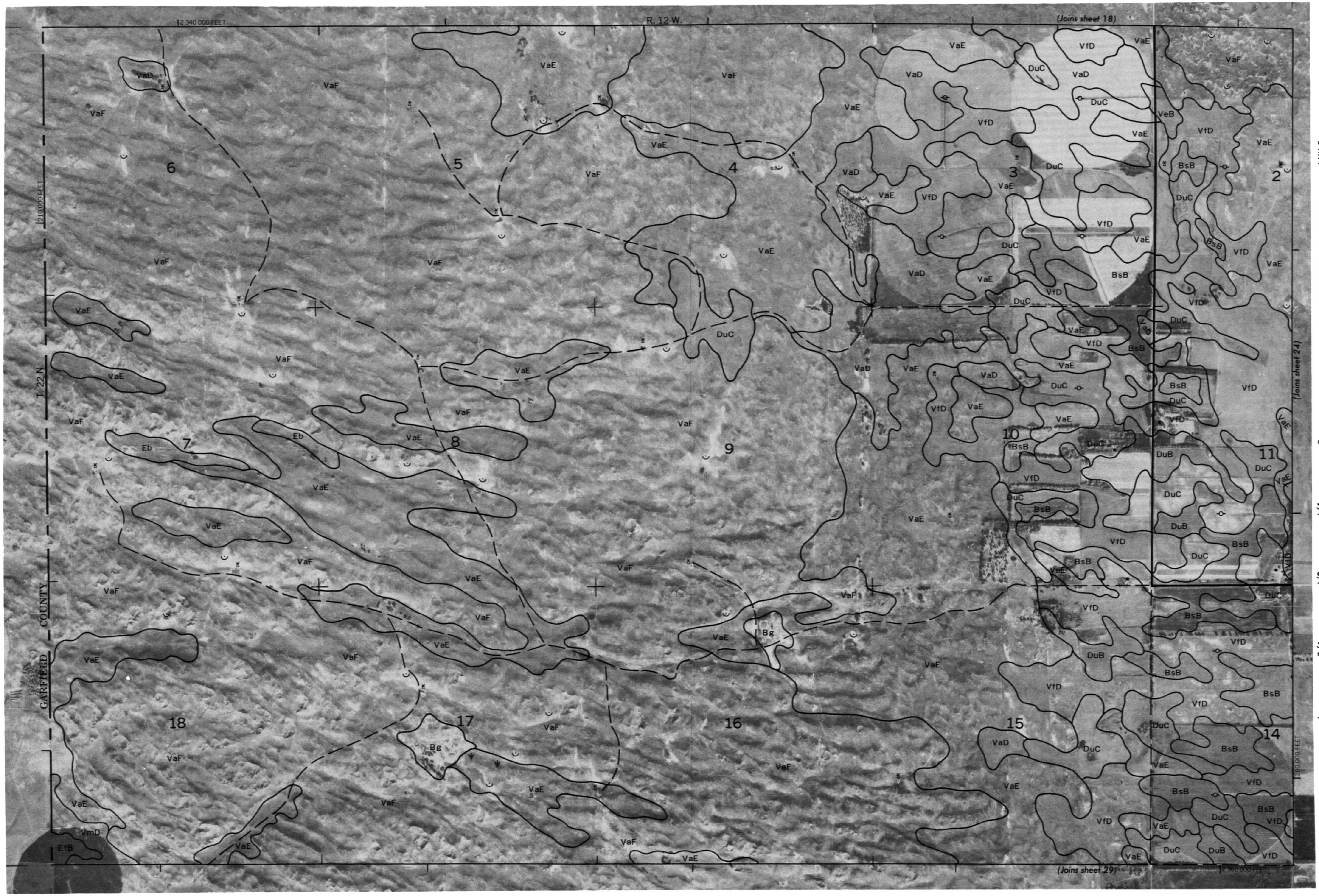


WHEELER COUNTY, NEBRASKA NO. 22

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

23

N



WHEELER COUNTY, NEBRASKA NO. 23

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

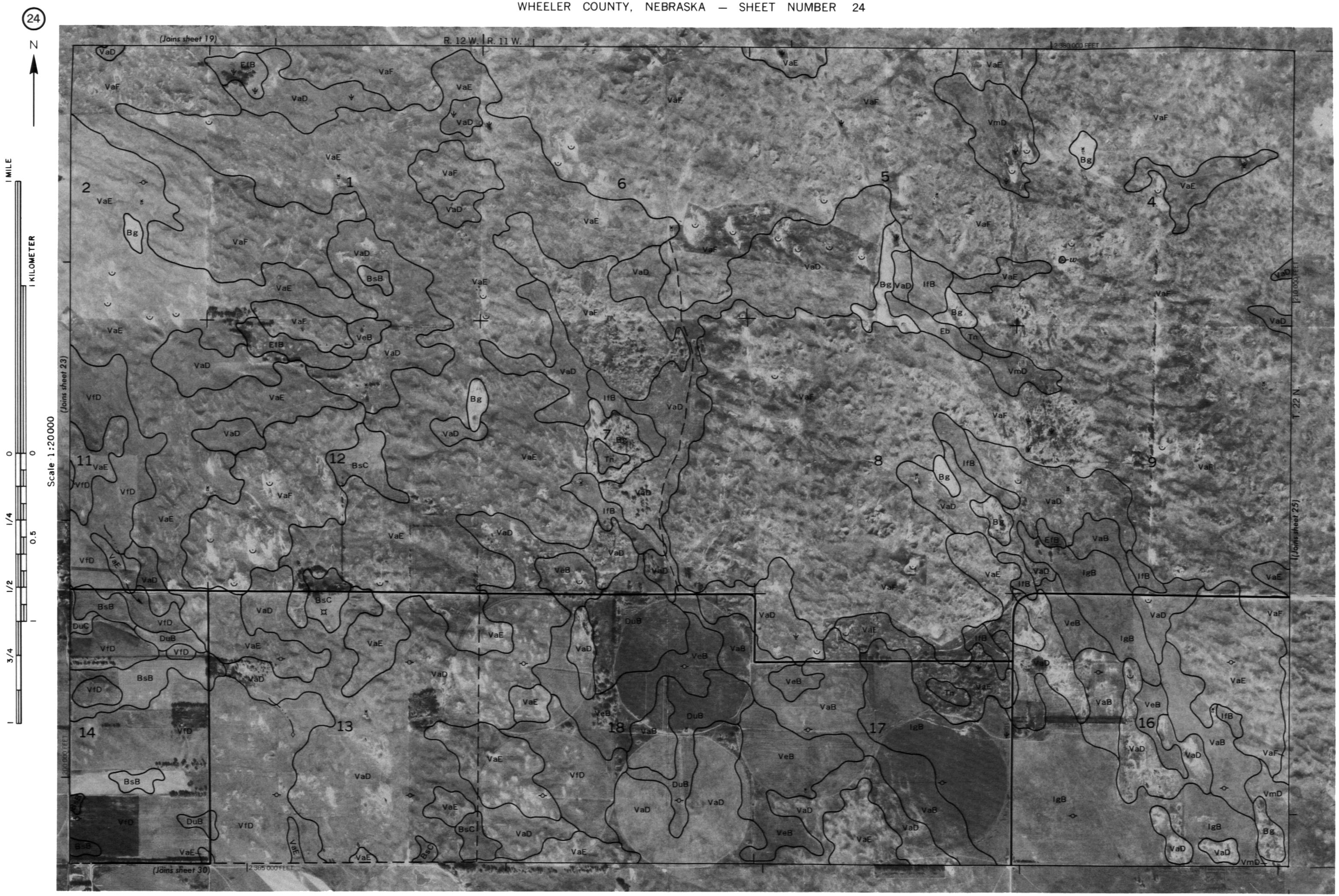
1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

Scale 1:20000

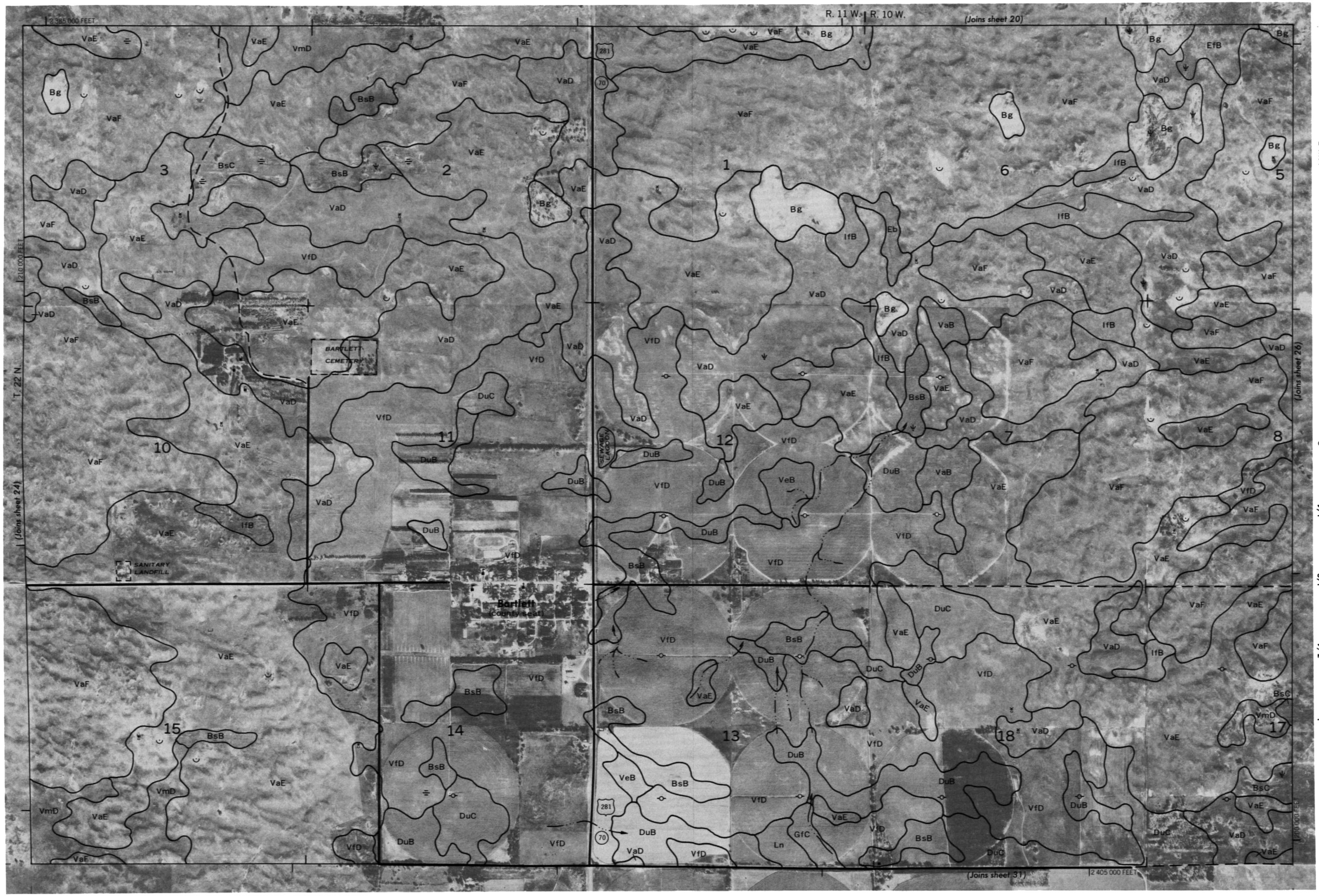


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

WHEELER COUNTY, NEBRASKA NO. 24

25

N



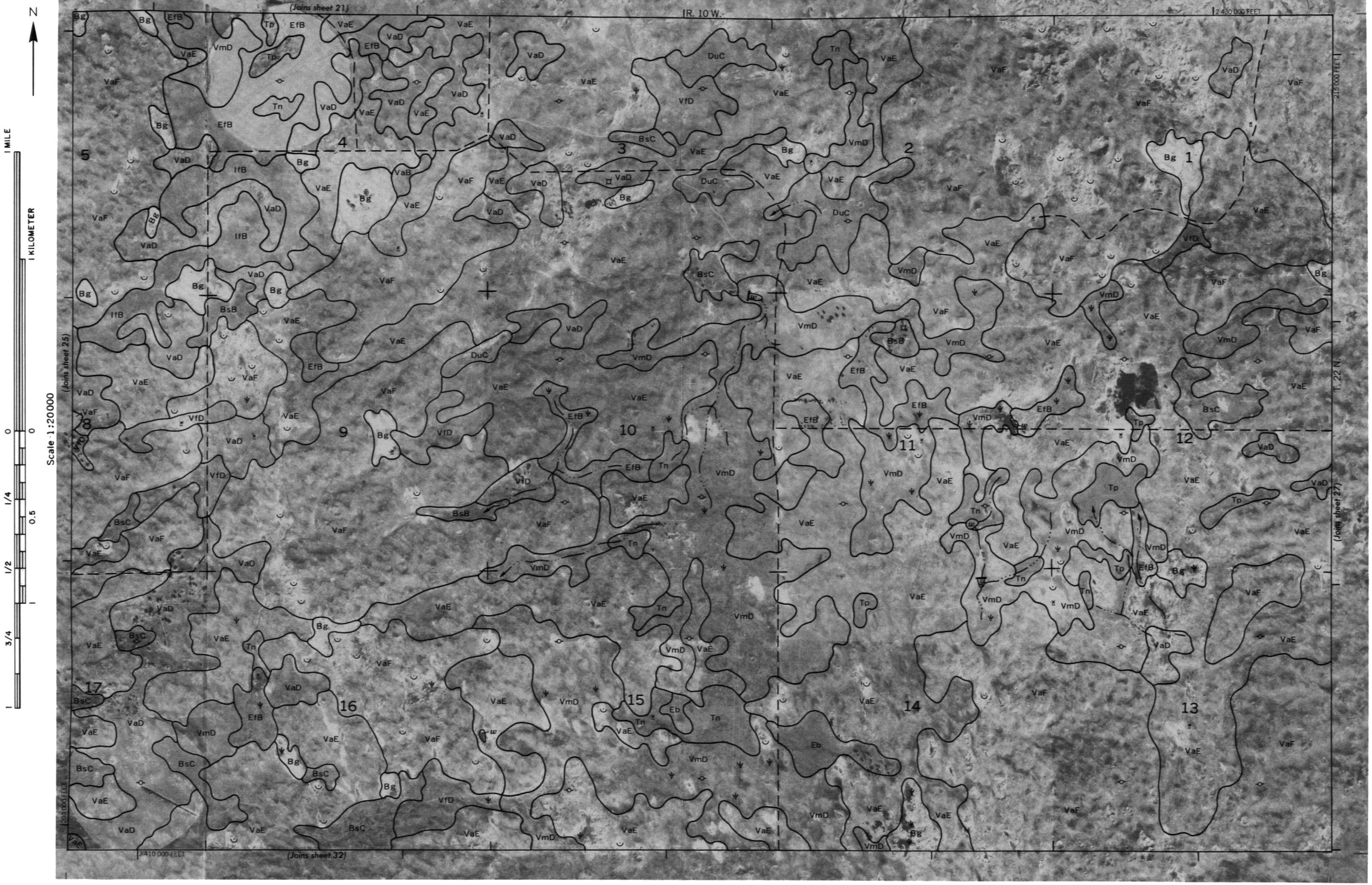
1 MILE

1 KILOMETER

Scale 1:20000

WHEELER COUNTY, NEBRASKA NO. 25

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

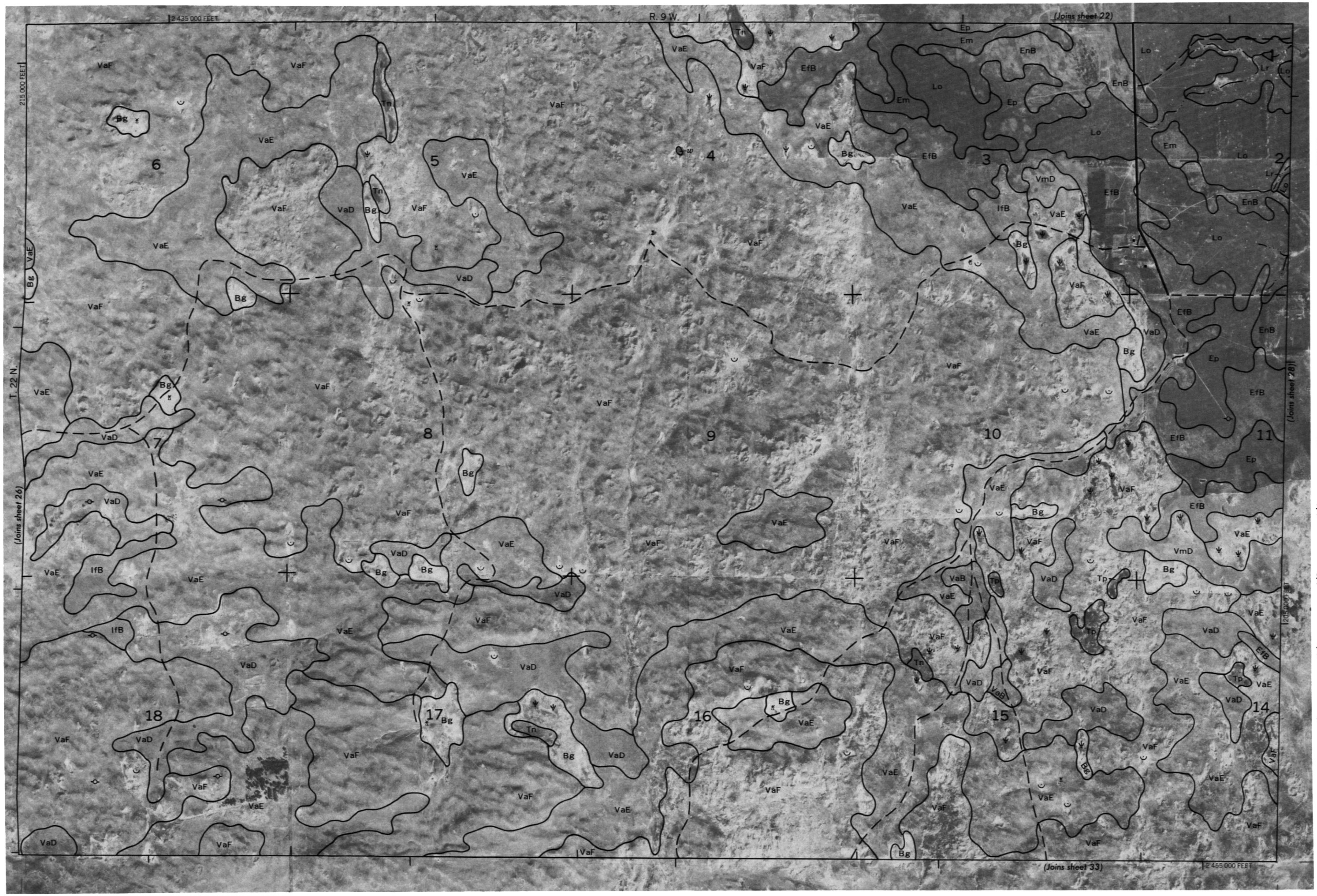


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA NO. 26

27

N



1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

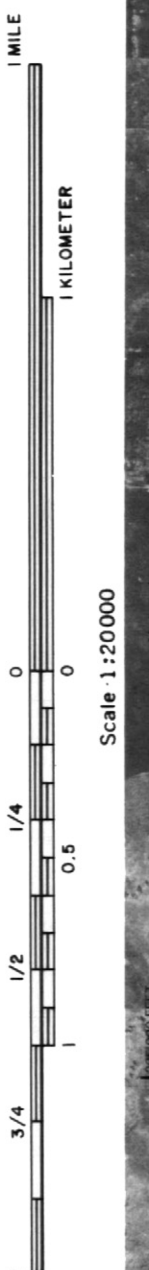
Scale 1:20000

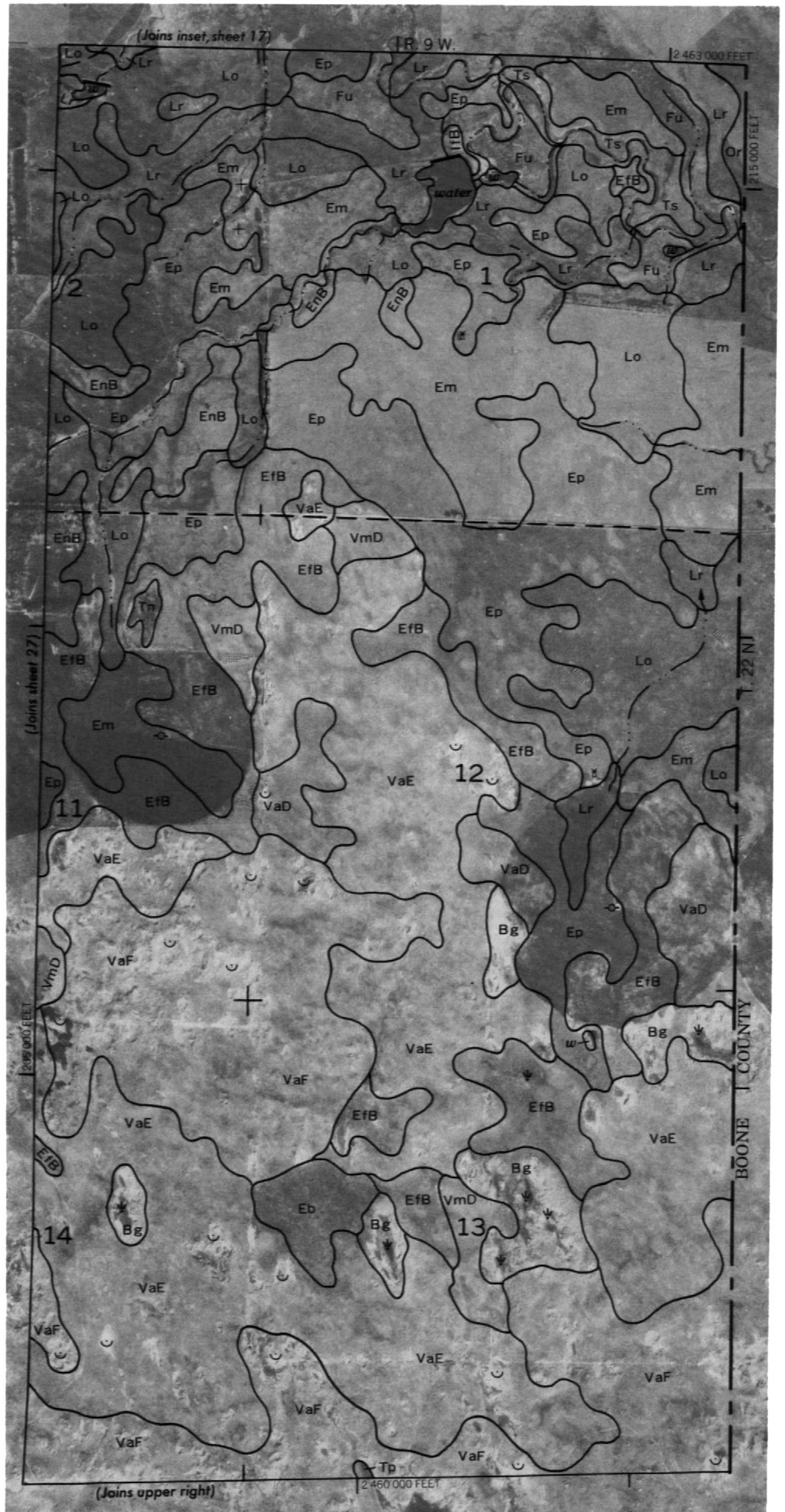
WHEELER COUNTY, NEBRASKA NO. 27

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

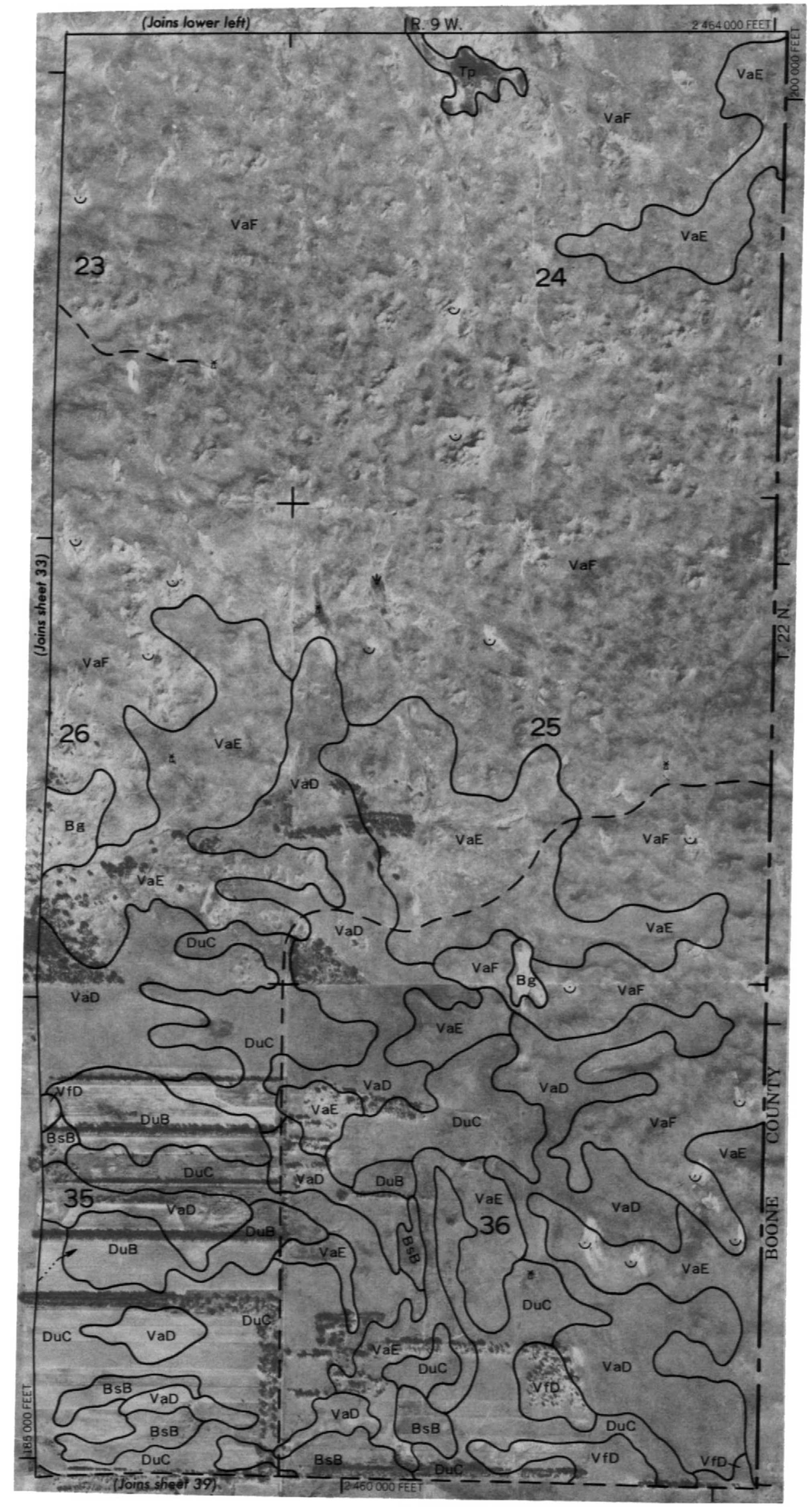
28

N





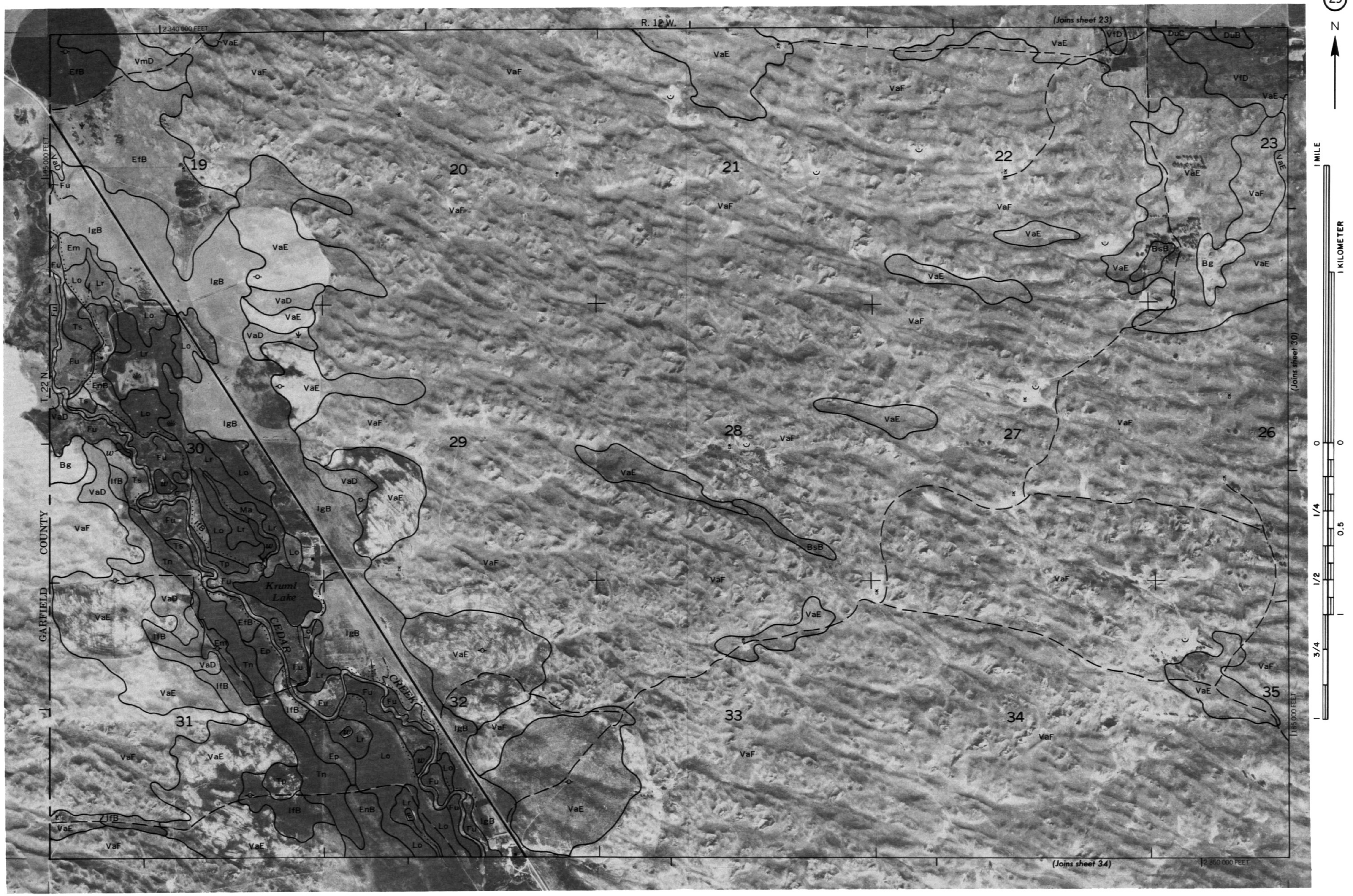
3000 AND 5000-FOOT GRID TICKS



4000 AND 5000-FOOT GRID TICKS

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA NO. 28



WHEELER COUNTY, NEBRASKA NO. 29

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

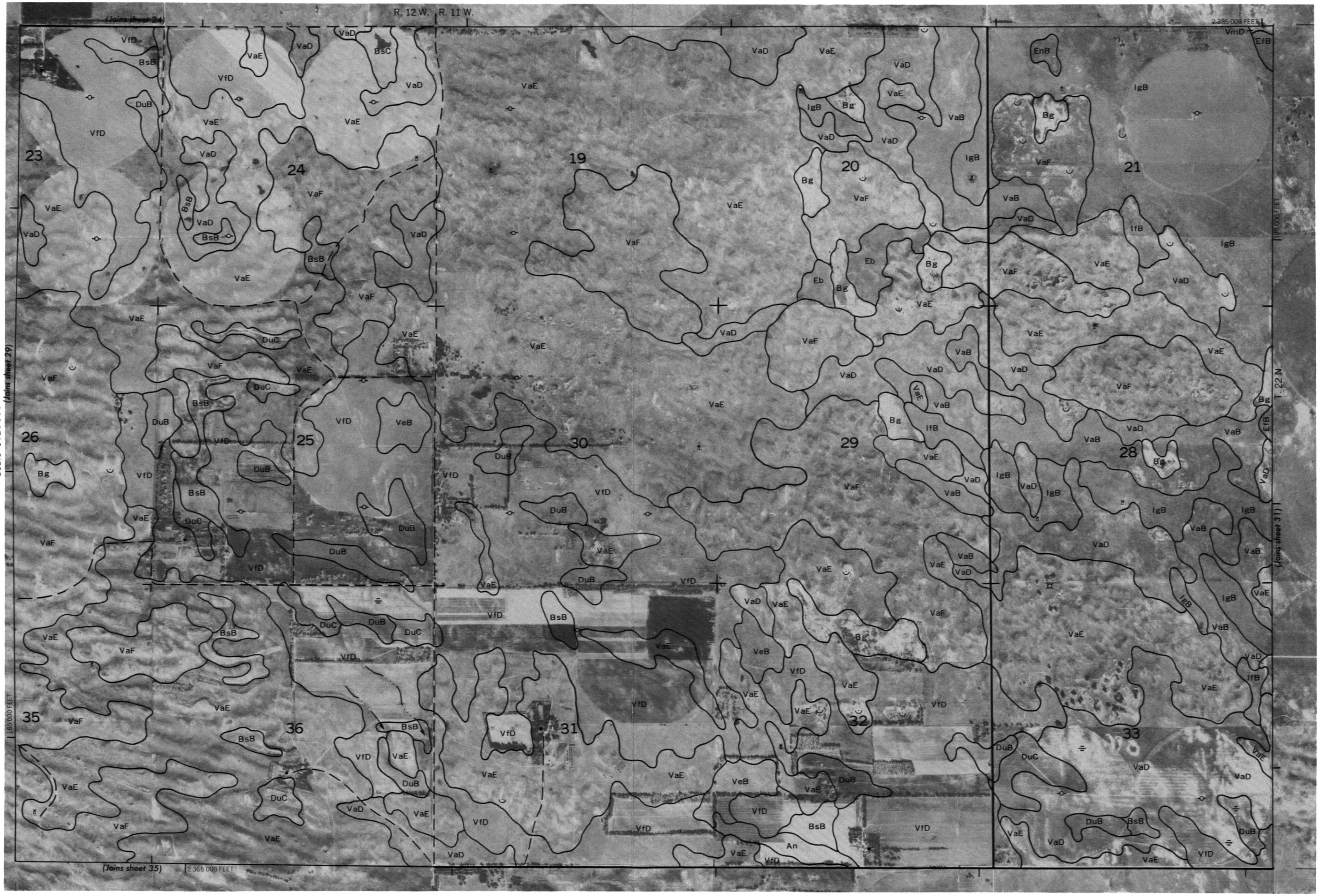
30

N

Scale 1:20000

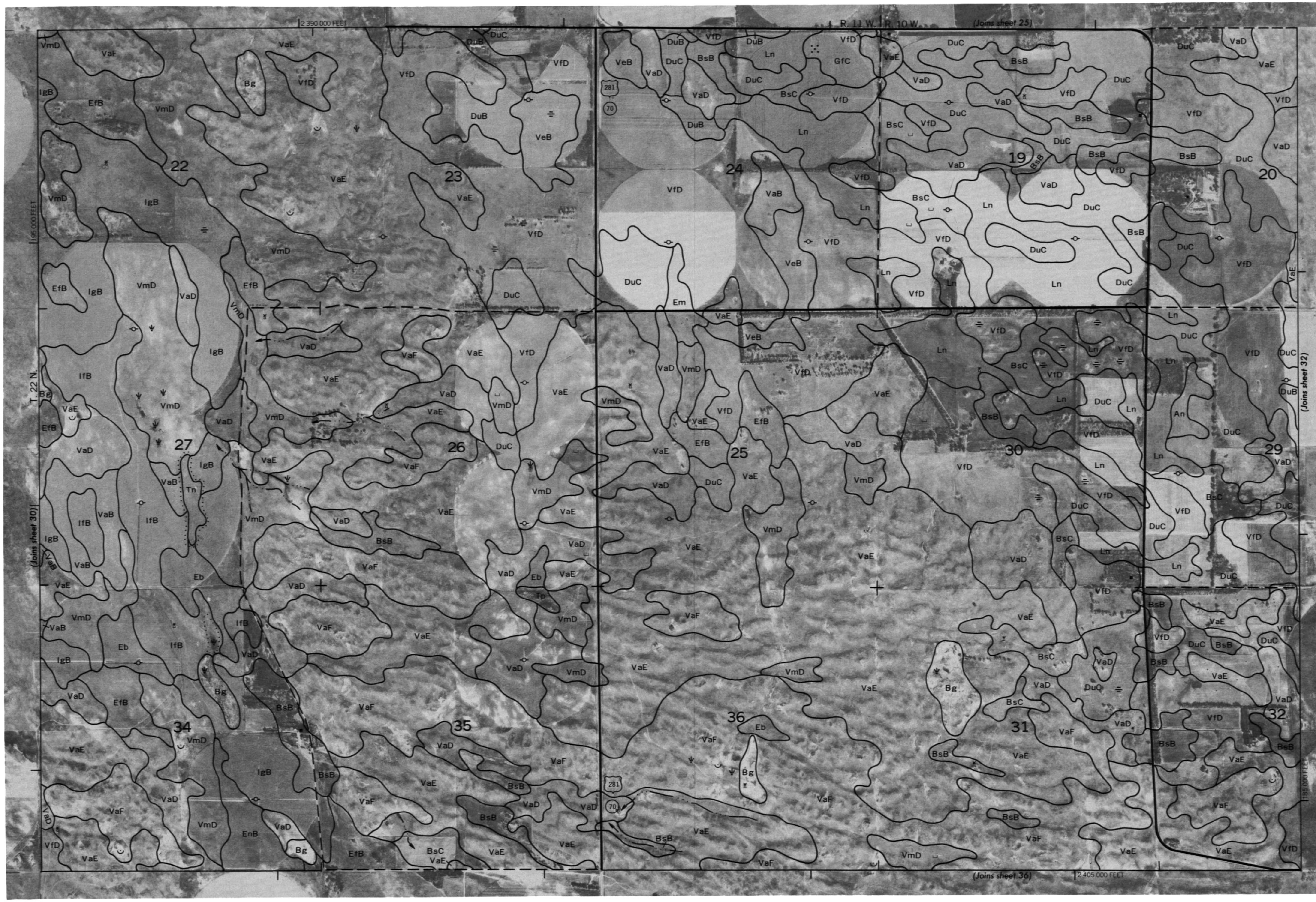
1 MILE

1 KILOMETER



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

31



N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

Scale 1:20000

WHEELER COUNTY, NEBRASKA NO. 31

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

1 MILE

1 KILOMETER

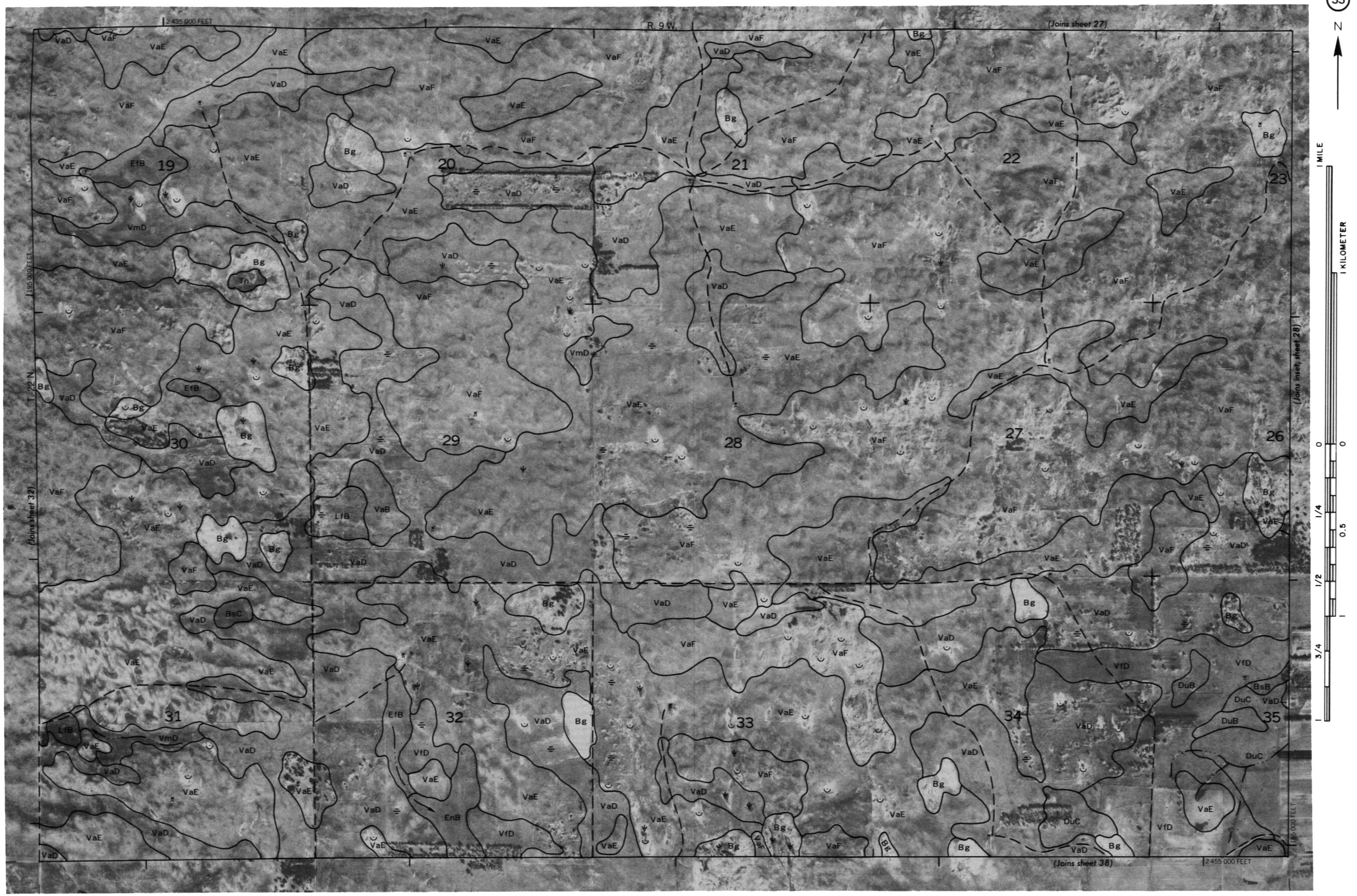
Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1

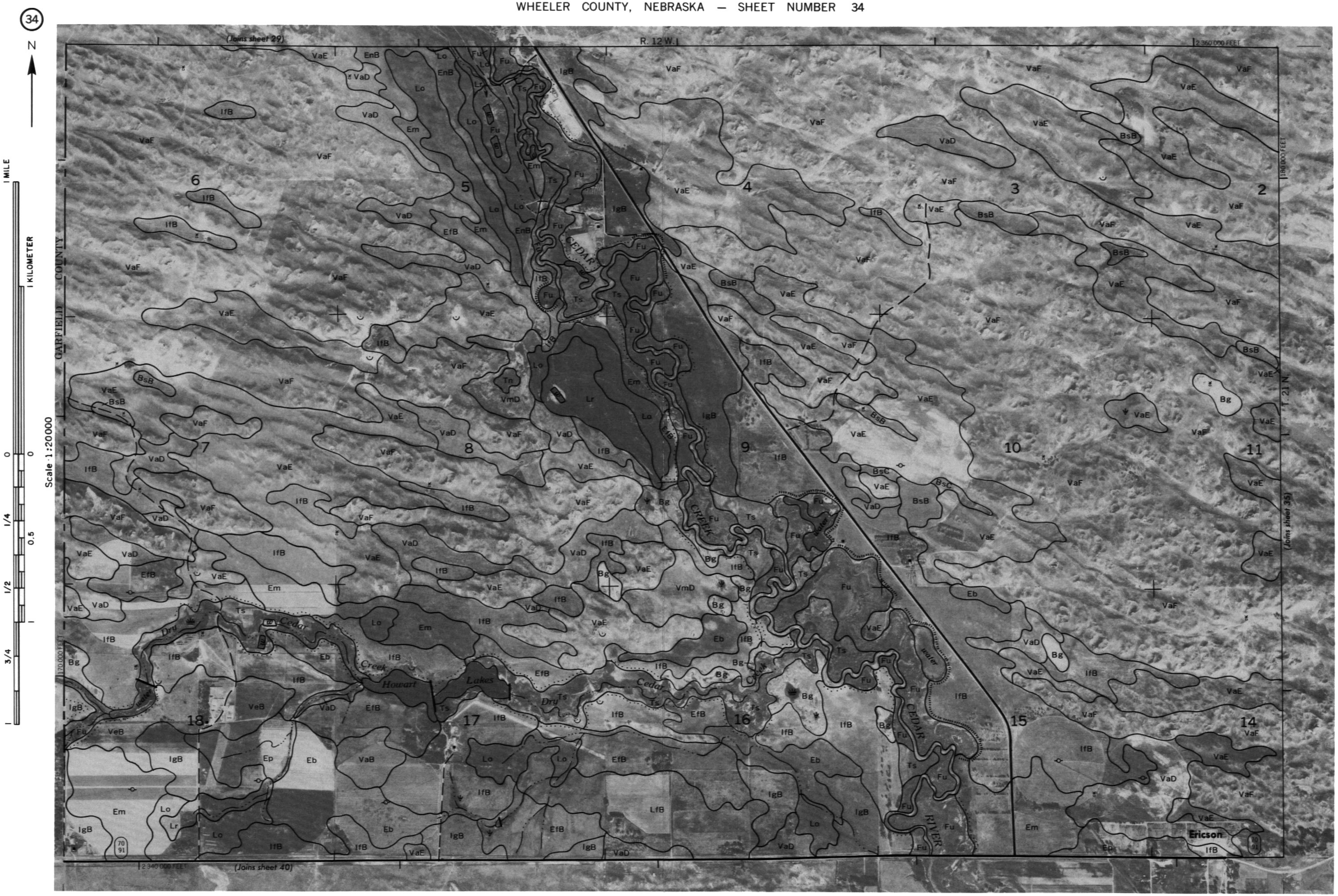
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA NO. 32

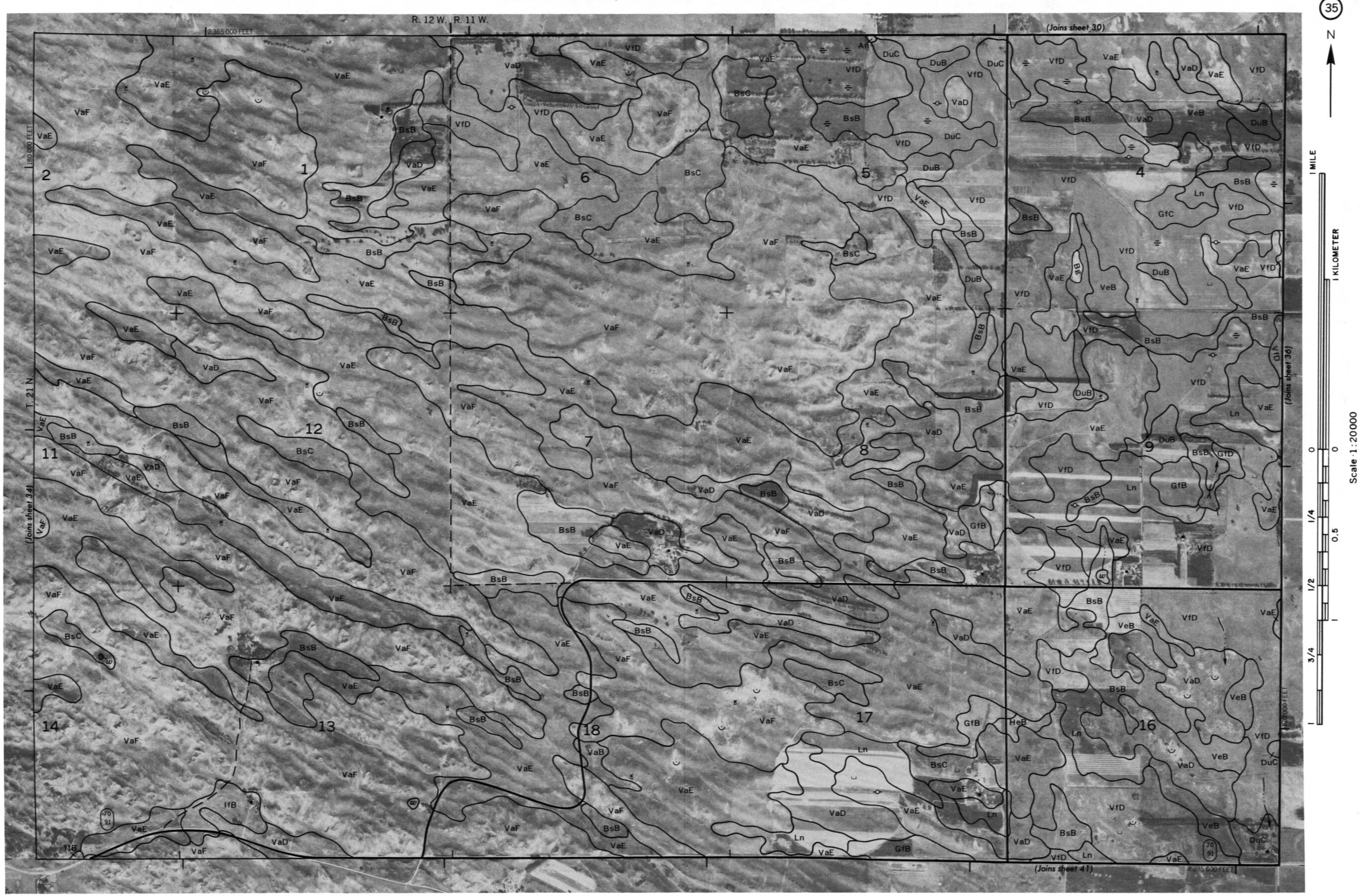


WHEELER COUNTY, NEBRASKA NO. 33

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

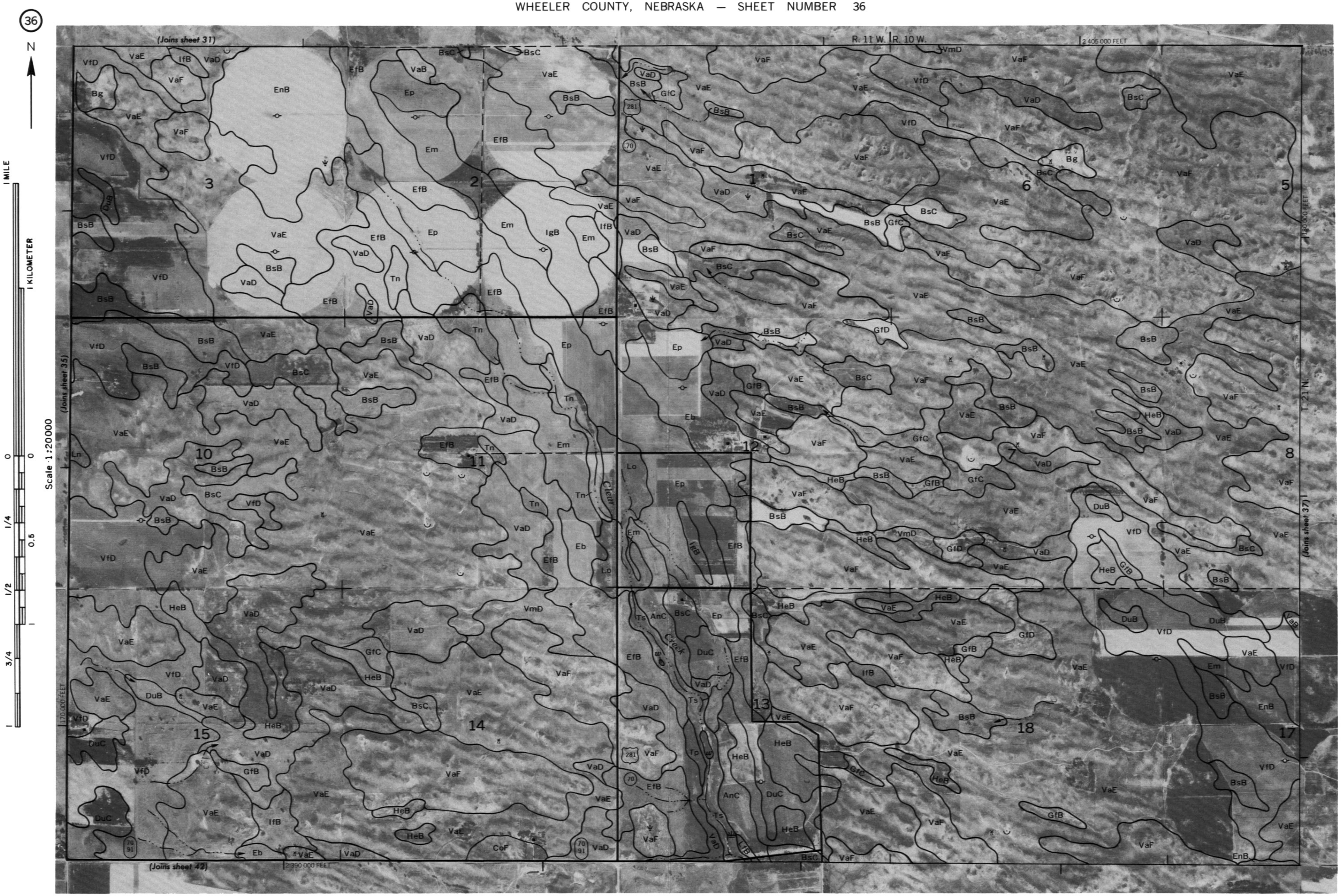


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned



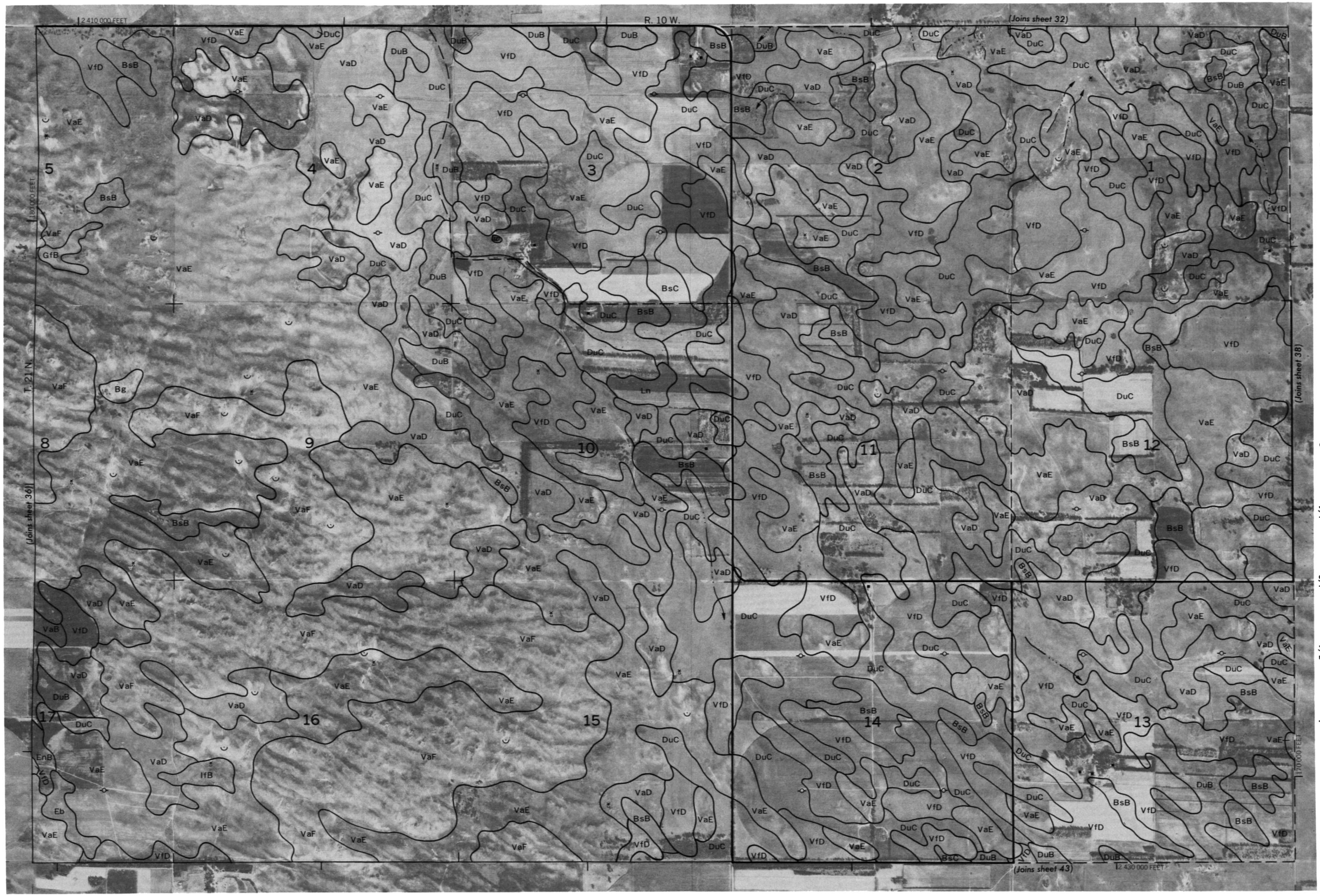
WHEELER COUNTY, NEBRASKA NO. 35

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA NO. 36



WHEELER COUNTY, NEBRASKA NO. 37

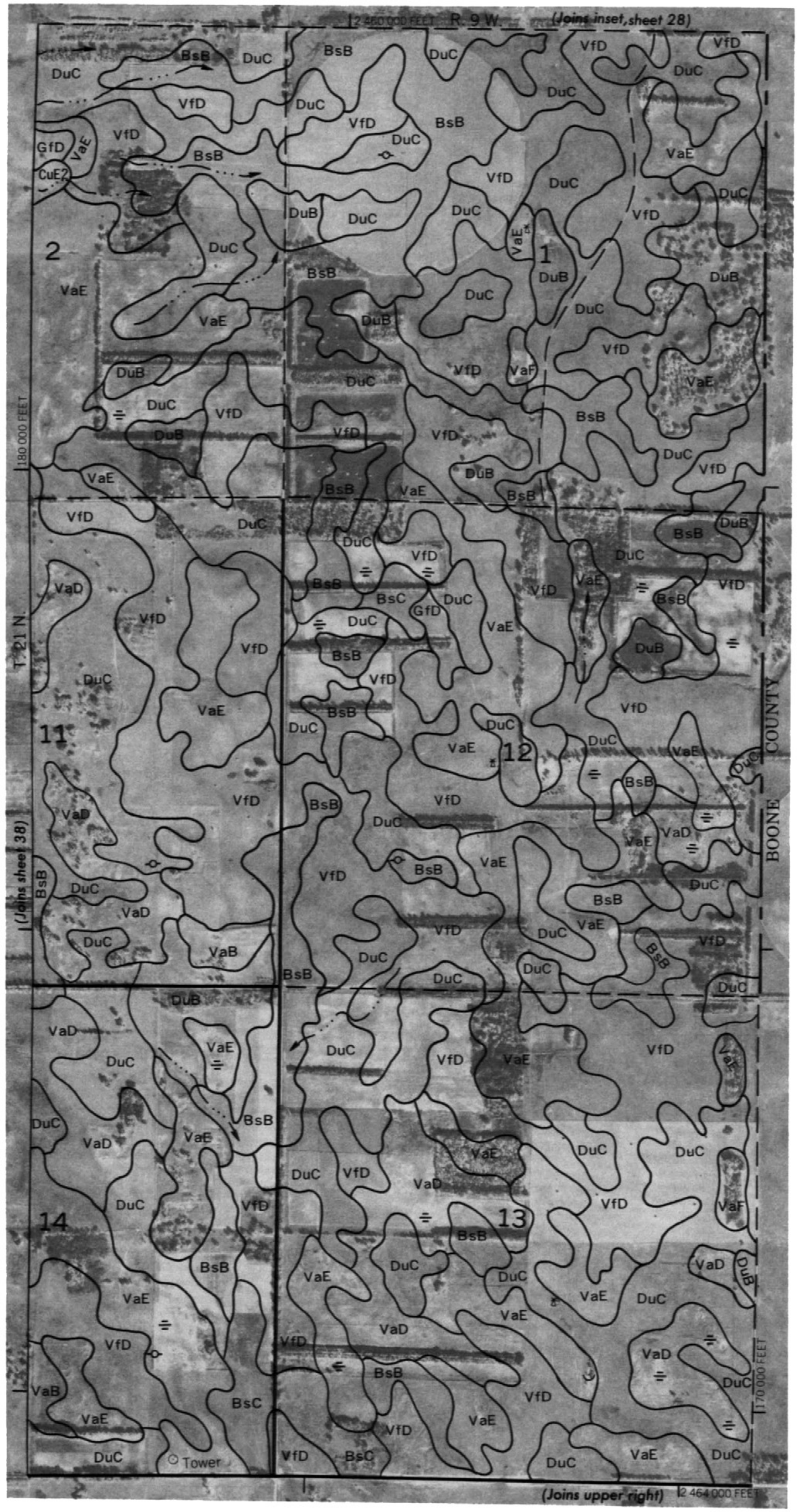
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

WHEELER COUNTY, NEBRASKA NO. 38

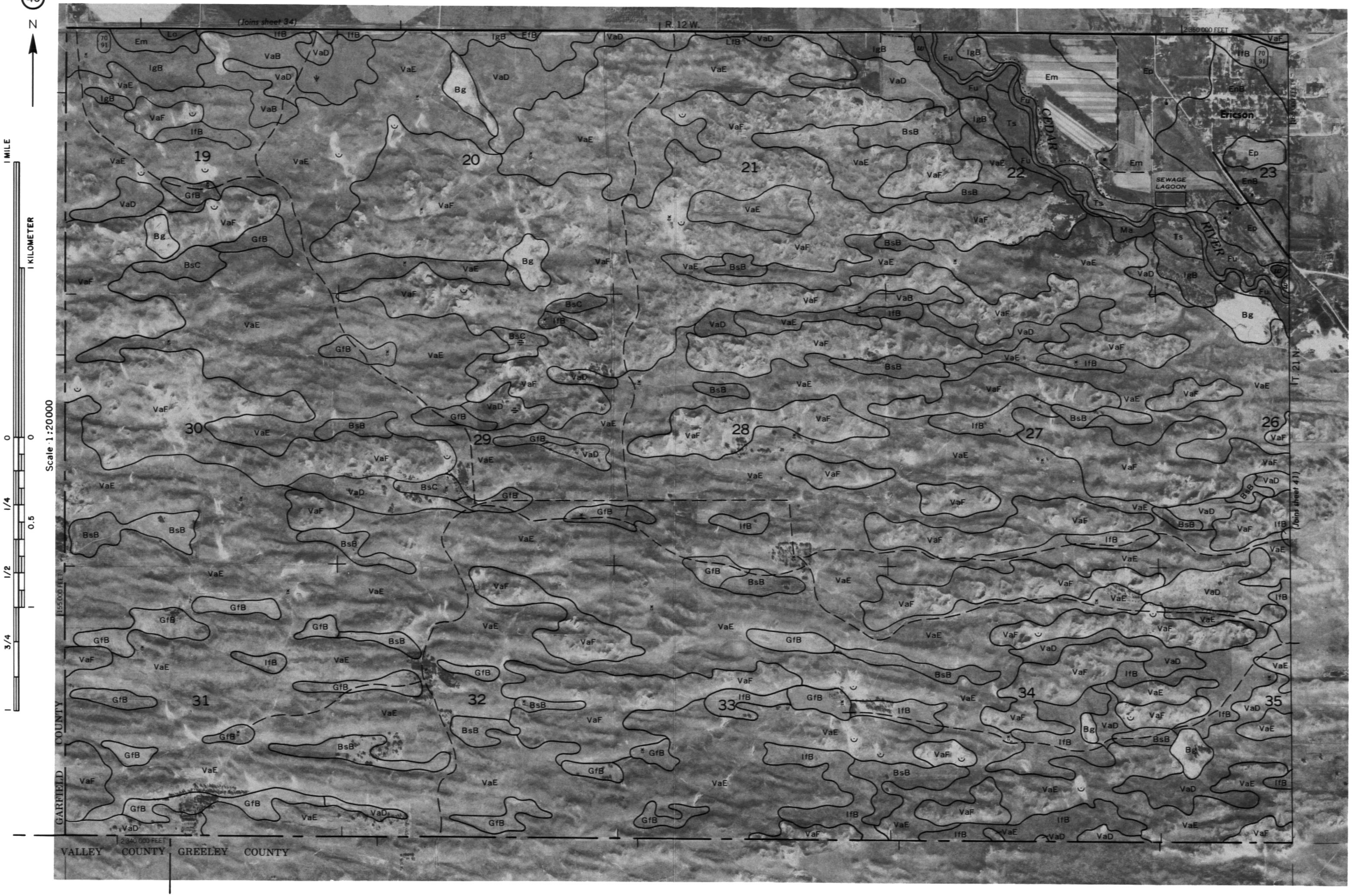
WHEELER COUNTY, NEBRASKA NO. 39

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



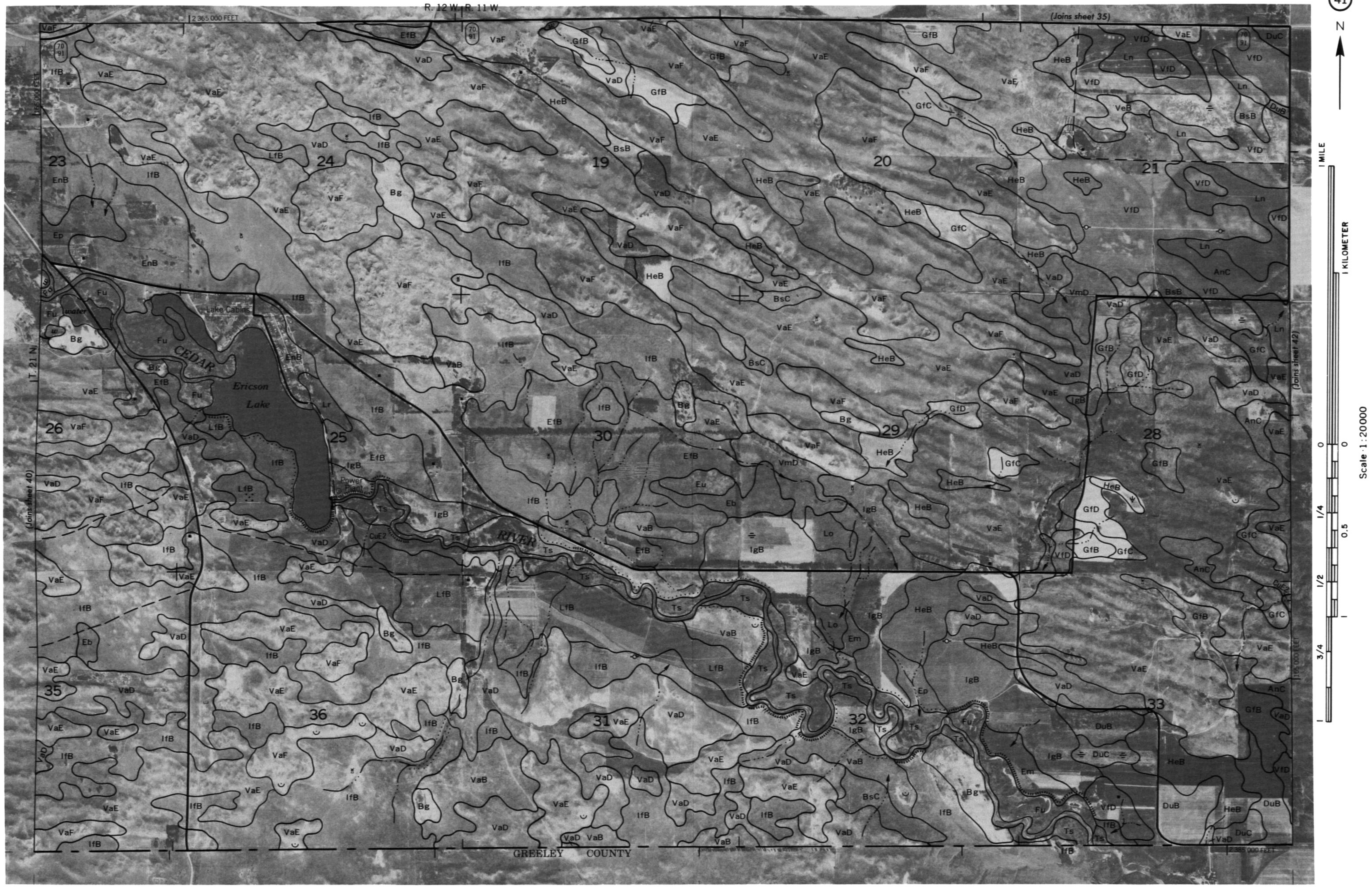
4000 AND 5000-FOOT GRID TICKS

4000 AND 5000-FOOT GRID TICKS



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WHEELER COUNTY, NEBRASKA NO. 40



WHEELER COUNTY, NEBRASKA NO. 41

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

42

N

1 MILE

1 KILOMETER

Scale 1:20000

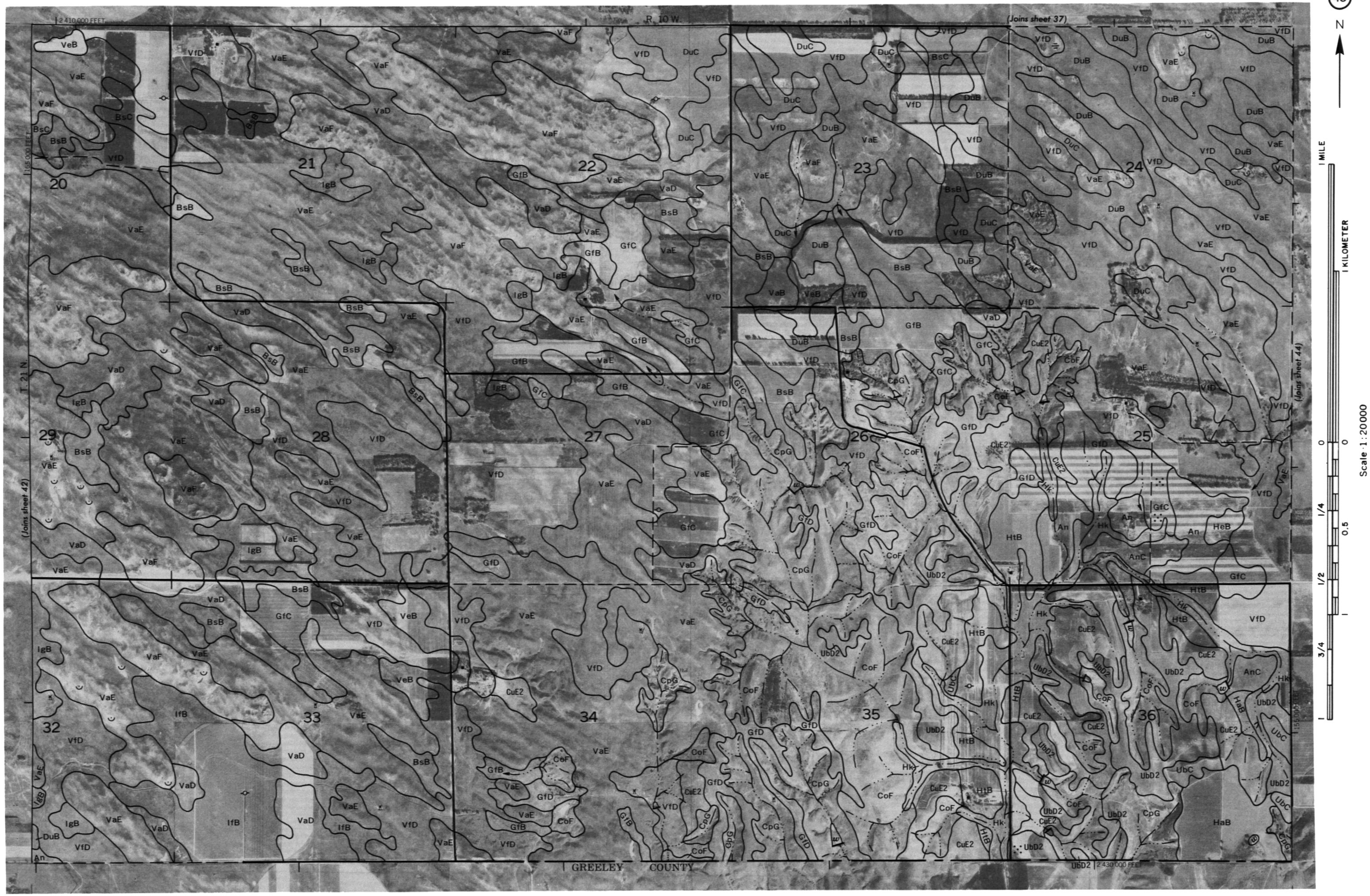
0 1/4 1/2 3/4 1

0 0.5 1

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

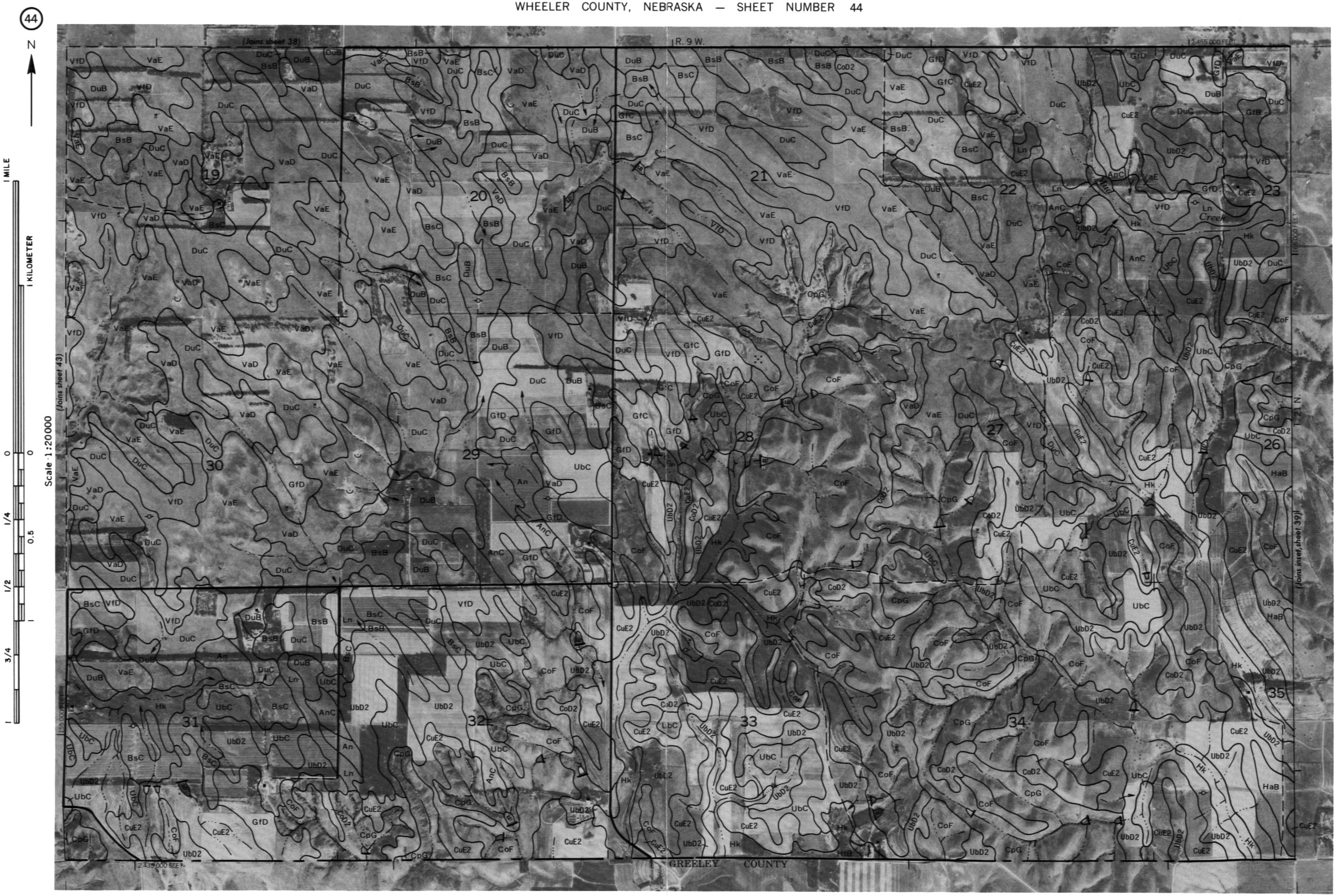
WHEELER COUNTY, NEBRASKA NO. 42

43



WHEELER COUNTY, NEBRASKA NO. 43

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

WHEELER COUNTY, NEBRASKA NO. 44